Draft
final
report

Jhum and development of Horticulture in Arunachal Pradesh

Prepared for:

North Eastern Development Finance Corporation Ltd.
(NEDFi)

TERI
North-Eastern Regional Centre

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To be elaborated in detail

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Jhum and development of horticulture in Arunachal Pradesh

Introduction

Shifting cultivation or jhum has been a major form of agricultural production in the hill states of the North Eastern Region including Arunachal Pradesh. However population growth has considerably shortened the fallow period resulting in the decline of crop yields and farm incomes, increased soil erosion, loss of secondary forest, and reduced biodiversity. Agriculture, which is the main sustenance for the people in the state, guides and determines the socio-economic relation and cultural life. Most of the traditional festivals of the tribal people appears to be linked to their origin in agriculture practices and they are observed in different seasons corresponding to various phases of crop cultivation. Traditional agricultural practice, which is mainly shifting cultivation, has been in practice since time immemorial, but the techniques of agriculture would vary depending on the agro-climate conditions and topography. There are two major types of cultivation practised viz. Jhum or shifting cultivation and wet or settled cultivation.

Jhum or shifting occupies the major area amounting to 1.10 Lakh hect. and is a major activity for sustenance. Jhum fields are generally the hill slopes and each family owning Jhum fields have a new and an old plot simultaneously each year. The Jhum cultivation usually starts from September- October with the felling of the trees and shrubs, December – January are the time for burning, followed by sowing from January – March, and may differ according to the agro-climatic variations. The crop is usually maize, millet, tapioca, vegetables like gourd, pumpkin, chillies, ect These crops are for the new Jhum fields, with paddy and tapioca (Katchu) in the old Jhum field, with no improved crop management practises and inputs has been utilised in Jhum.

Settled or wet cultivation is practised in the narrow valley adjoining the rivers and most of the wet cultivation areas have been terraced, which are prepared either by plough or the hoe and broadcasting and transplanting methods are used. Cultivators divert a part of the streams for irrigating the fields and in other situation are dependent on the rainfall. Crops cultivated are paddy, maize, wheat, pulses, and oilseeds.

It is high time that introducing alternative methods of farming permanently discontinues the practice of jhum. Arunachal Pradesh has tremendous scope to introduce horticulture as alternative jhum.

North Eastern Development Finance Corporation Ltd. (NEDFi) has invited proposals from experienced individuals/consultancy organizations/NGOs/Institutions to prepare a project report on status on jhum cultivation in Arunachal Pradesh and development of horticulture as alternative to jhum.

Objective

The proposed study *Jhum and development of horticulture in Arunachal Pradesh* is essentially a pre-investment feasibility exercise. Its objective is to bring about improvement in income of farmers and conservation of natural resources through establishment of agri-horti-silvi farming as alternatives to shifting cultivation.

Scope of study/study area

The study shall cover the state of Arunachal Pradesh and West Kameng district has been identified as the potential area for the demonstration of the model rehabilitation package.

Project Tasks

Assessing the status and impact of jhum cultivation in Arunachal Pradesh

The focus will be on understanding the level and extent of jhum cultivation in the state, dependence of local community on jhum, crop diversity, the existing occupational pattern and sources of income and finally the economics of such agriculture practices and its impact on the environment (natural resources) will be determined.

Identification of horticulture crops as alternative to jhum

This will involve the identification of agricultural, horticultural, medicinal and forestry crops, suitable for local conditions (climatic, edaphic, technology transfer, etc.) will be identified to be promoted as alternative crops in jhum areas. Analysis of the existing government and private schemes for rehabilitation of jhum farmers, and the evaluation of the same for the effectiveness of such programmes will be undertaken. Further, The prospects of developing organic farming and the availability of associated inputs will be explored.

Design of model rehabilitation package

The development of a rehabilitation package for *Jhum* farmers would constitute an agroclimate specific model (local adaphic) that could be replicated in other districts of Arunachal under similar environment. However four agroclimate specific models covering the entire state would be prepared simultaneously for developing a comprehensive rehabilitation package. The Initial design for a cluster of villages will include methodology to implement the project, sources of financial assistance, details of technical know-how, capacity building (training) of the farmers, analysis of the infrastructural support facilities and the market linkages. The process to elicit participation of the beneficiary in planning and implementation of the project will be formulated for its sustainability. The proposed package will determine the economic opportunities associated with shifting over to horticulture crops and explore the possibility of forming co-operatives for farming.

Assessment of statutory, regulatory and social issues

The aim will be to identify the level of dependence of the communities on forests, land and water resources for jhum cultivation and how this is governed by statutory and customary laws. Analysis will be made to assess the likely social impact due to shifting to sedentary horticulture farming. Emphasis will be on assessing the effect on the traditional values of the community. The barriers to adopting alternative farming will be identified in the context of existing socio-cultural milieu. The focus would also be on the apprehensions and priorities of various stakeholders regarding the rehabilitation package and how the traditions can be safeguarded against dilution of customary laws.

Identification of project implementation agency

The available and required institutional set-up for project implementation will be determined. This will involve interactions with existing state/district/block/village-level institutions, and local financial institutions. For the effective execution and supervision, institutional structures required will be recommended. Such structures and mechanisms will also be able to adequately handle grievances/conflicts that may arise later. The state government agencies and local NGOs would have a major role to play in the proposed mechanism. Alongside, indicators and procedures for the monitoring and evaluation of the project will also be suggested.

Also, a public information strategy will be developed, such that a time schedule for implementation can be developed with the people and the community is regularly informed of the developments taking place.

Approach and methodology

The project tasks are being undertaken using a logical framework approach, wherein the knowledge, attitude and practices regarding jhum cultivation existing at the institutional, community and individual levels have been given due credence. The proposed study involves extensive original (primary) data collection with support from secondary sources (concerned state departments, institutions, published literature, etc.). For primary data collection, a participatory approach will be adopted, wherein interactions with the concerned stakeholders will be sought to gather the relevant information.

The approach and methodology adopted relates to undertaking a

1. Primary desk research for secondary information already available
2. Preparation of interactive tools with government officials, development agencies and financial Instutions
3. Undertake pilot survey in the potential districts
4. Field survey and participatory rural appraisal at the selected area for facilitating the rehabilitating package.
5. Dividing the state into six major sub- basins, namely Tawang and Kameng river basin, Subansiri river basin, Siang river basin, Dibang river basin, Lohit river basin and Tirap-Dihing river basin for inferring the influences of various parameter related to soil type, slope, water availability, drainage, rainfall, climate, vegetation, land use and land cover, distribution of settlement, etc. on the soil loss and soil fertility, crop productivity and farm income, environmental degradation, siltation in reservoirs and occurrences of floods and climate change attributes from Jhuming.
6. Another approach has been to divide the state into the different agro-climatic zones prevalent in the state and understand the interactive parameters as stated earlier and develop a crop plan for promotion of horticultural crop under specific agro-climate zones.

Secondary data collection

Information collection from secondary sources involved desk research as well as visits to concerned government agencies and institutions. The former exercise entailed culling data from relevant websites, and published literature (journals, books, reports, etc.) Chronological records and statistical databases maintained by government departments proved to a valuable source of information. The parameters that have been taken into account are presented in the Annexure I.

Primary data collection

Given the project tasks, including the design of a rehabilitation package, the collection of information from the field becomes imperative. The objective was to fill the data gaps identified during the secondary data collection as well as solicit the participation of the relevant agencies and community in the project planning and implementation. Thus block level primary survey and participatory rural appraisal (PRA) at the cluster of villages identified on the basis of a watershed approach has been undertaken. Besides discussions with resource / knowledgeable persons and institutions was also undertaken to strengthen the approach for planning and development.

Meetings with resource agencies/persons

Concurrent with the village/household surveys, meetings were held with individual knowledgeable persons and representatives of government departments, and institutions working on issues of relevance to the proposed study. The aim is to gain their perceptions about the proposed project and elicit collaboration and support in planning and implementation of the rehabilitation package.

Village survey

The village survey focuses on the cluster of villages identified for the design of the rehabilitation package. The survey will identify the land-use pattern, and infrastructure facilities related to water, agri/horticulture, energy, markets, etc. The emphasis has been on determining the communities' dependence on jhum cultivation and the role of village level institutions in sustaining this practice. The ramifications of the proposed rehabilitation package in light of the prevalent statutory and customary laws have been explored. The prioritisation of the community needs with regard to agriculture development has helped to determine the intended impact of the package.

Participatory tools for information collection

- *Community meetings.* The objective of organizing such meetings in the villages was to gather the views of the community at large. Specifically, results of individual/key person interviews and focused group discussions can be presented in such a forum and community agreement on problems/concerns voiced by individuals or groups can be arrived at.
- *Natural group interviews.* Casual conversations were carried out with groups of farmers in their natural settings, for example when working in the jhum fields. These will form a part of 'participant observation' approach. This will help in getting some broad sense of the community views on specific issues, e.g. access to cultivable land, productivity, credit for agriculture operations, irrigation facilities, etc. as well as their views on the proposed rehabilitation package.
- *Focused group discussions.* This semi-structured discussion was carried out with different stakeholders such as jhum farmers, women, practising

horticulture farmers, etc. A list of open-ended questions was administered to focus the discussion around the issues of concern that would help in determining the community's preferences and expectations, needs and attitudes towards rehabilitation.

- *Key informant interviews.* Semi structured interviews with key informants, such as the village gaonbura (headman), village council members, Anchal Samiti members, agriculture extension workers, etc. was undertaken in obtaining specific, in-depth, quantitative and qualitative information on specific issues.

It is important to mention here that some of these tools when applied will help in getting data/information on more than one single task. The selection of the tools has been done keeping in mind the ability of the community to respond to written, oral or visual presentations; and the ease with which the community can be organized to voice their opinion on a matter/issue as a collective group. Past experience shows that working with groups (formal and informal) is relatively easier with people living in rural areas.

Overview of the study process:

The study on Jhum and Development of Horticulture in Arunachal Pradesh is an extensive study which involves assessment of enormous secondary information that range from horticulture, agriculture, land use, forest, water, etc. which would ultimately help in planning and development for winning away the jhum cultivators through the development of a package which is realistic and acceptable. Besides assessment of the schemes would be the driving mechanisms for development of the rehabilitation package, where village communities, NGOs, local entrepreneurs would be guided for sourcing of funds and bring forward the necessary linkages towards the Line Departments, Ministries and Donor agencies.

As the study (Plan) covers the entire state of Arunachal Pradesh, horticultural crops in each district have been identified & performances for the last 10 years (*secondary data*). The area under Jhum under each district has been inferred with reference to the NRSA, Waste Atlas of India 2000. Beside visits have been to the potential districts and circle wise information on area under Jhum, crop performances, community responses, and available infrastructure (*fruit collection, processing, Govt. farms, farmers training centre, seed farms, research centres, etc*) have been generated. A combination of the above parameters has been the guiding principle in proposing the areas for the rehabilitation package, besides it would also *help new entrepreneurs* venturing into the sector.

TERI has made a presentation to NEDFi on the proposed area for the rehabilitation package, designing interventions in a clustered approach considering the treatment of micro catchments' for effective implementation as an alternative to shifting cultivation. TERI undertook a primary data generation at a cluster relating to crop, land use, water availability, etc. with focused group discussion, natural group interview with the community for designing a model rehabilitation package.

Match of biophysical parameters (altitude, soil type, land capability, water availability, etc.) has helped in designing the crop plan upto the district and block/circle with respect to specific *agro-climatic zonation* for the entire state.

Besides the biophysical parameters has been utilized for inferring a number of inferences in relation to soil loss, potential areas under flooding, damage of road infrastructure, locate glacial lake outburst & floods (GLOF) areas, support infrastructure, etc. the entire effort has being based on *digitalisation of the data* generated. Numerous inferences with the help of maps under specific of the report have been made for a better understanding by planner/Govt. Dept/entrepreneur/ line departments undertaking by the various developmental activities in the state.

Realising the importance of the market forces towards horticultural crops, a market survey for assessing the inflow/outflow, commodity type and demand assessment have been undertaken (*unprocessed data provided in the inception report, section Market Assessment*) in selected areas (*Itanagar, Bomdila, Dirang, Ziro*) of the state. The areas selected are those where crop productivity is high and promising and at the secondary market at Guwahati, which is the area where fruit crops enter and exit from the region. Market survey were undertaken among the whole sellers and retail sellers for an understanding on issues related to flow of *fresh* and *processed fruit* products, the varieties, their demand, seasonal availability, price fluctuation, source of procurement, identify regional, national and international companies and corporates, post harvest technology (PHT) applied, etc. The entire approach would help towards commodity modelling (*identifying the potential fruit crops that can be promoted to compete with those established in the market, through the identification of the gaps, constrains, and potentials for fresh & processed fruit products*). Besides the approach has helped identification of the brokers, companies (*regional, national and International*) operating in the region with fruit products that are being available in the region, which could be linked for collaborative venture with known pricing of products.

Promoting local crops has been the major objective under the said study, and the said approach is already being taken into consideration in designing the section *identification of alternate crops, designing agro climate specific model, a location specific is being planned for the* rehabilitation package. A detail survey of crops under jhum during the primary survey (model package) has been undertaken which has been incorporated in the report. Besides secondary information on the local crops (*fruit, medicinal, vegetables, etc*) and crops under Jhum is very limited. To over come the said gaps consultation and guidance from State Forest Research Institute (SFRI), National Bureau of Plant Genetic Resources (NBPGR) was also undertaken.

The strategy for the *proposed land use*, in the state specific to tropical and subtropical areas has been planned based on the inference that are drawn from the combination of the various *biophysical parameters*. The study has identified the Jhum zone in the state, compared the possible impact in relation to natural parameters like geology, hydrogeology, land capability, drainage characteristics in the river basins, monsoon effect (precipitation), etc. and has brought forward interventions (*crop plan, land & water resource management with efficient ground cover*) which has been reflected in the model.

Jhum cultivation cannot be transformed into settled cultivation through a change in the present traditional land use pattern, without taking the community into confidence. Intervention can only be promoted in a phase manner through community action and in a reciprocal approach by intervening in the fallow manor abandoned Jhum lands without bringing about a change in the land topography.

Slowly but steadily building on an agro-forestry model combined with traditional management system which would combine the production of forestry species, fruits plant, herbs/medicinal plants, cereals, vegetables, placed according to slope and altitudinal variations, requirement, land capability and land availability. The overall approach & objective would be to bring about an enhancement of food production (*which is a basic requirement*), provide fuel wood, and cash crop production, improve soil fertility, and all this would be in conjunction with the *cultural practices of the local community*.

Effect of jhum cultivation on the natural environment, resulting in erosion, deforestation, decline of flow in streams, runoff concentration, effect on flood hydrology quantification of soil loss in the study area, would be controlled by various parameters (*natural and artificial*) and would vary from river basin to river basin. Under the present study we have been able to draw attention to the subject *siltation and occurrences of floods* in Arunachal Pradesh and have been able to identify the major influencing factors, areas to be affected under GLOFs, mass waiting, floods & siltation zones, etc.

The proposed model rehabilitation package addresses some of the issues by facilitating maximum ground cover strategies through Bioengenering techniques (*hydrological control, infuse soil to the parent rock / base according to the nature and orientation of the beds/formation*), with less importance to physical barriers, which are costly and require frequent maintenance and can be highly unstable in the

Himalayas. Undertaken a detail area specific management plan would reflect the management strategies form proposition.

Climate attributes and changes in the Arunachal Pradesh Himalayas is being undertaking through the inferences of climate data on rainfall, temperature from the rain gauging stations located in the district head quarter. The said exercise is being undertaken through secondary data available with the Rural Works department (RWD), in addition to the data available with the Directorate of Economics & Statistics. The rain gauge stations selected are according to the altitudinal variation (500 m to 3500 m) and spread through out the state (*polygon method*).

Family income from Jhum, per capita income of the families practicing Jhum, has been evaluated during the primary field survey under the rehabilitation package exercise through group discussion with Jhum cultivators. Location specific farm technology has been suggested in addition to the broad management practice under different agro-climatic zones. Soil chemistry has been inferred from National Bureau of Soil survey and Land use planning (ICAR), under the section Agro climatic zonation sub: soil types (*soil of warm per-humid eastern Himalayas, soil of warm-perhumid, siwalik hill ecosystem, soil of hot humid, plain ecosystem*).

The proposed area for the model rehabilitation package is being undertaken in the area (altitudinal range 500 – 2500m) where Jhum agriculture in under practice, and the proposed area under West Kameng district has been identified based on the identification of the micro catchments (*with habitation/villages*).

As a major area of Arunachal Pradesh has steep slopes where strategies and sustainable planning and conservation strategies has to be generated for the *steeplands*. Natural hazards in the elevation zone >500 to 3500 m, where jhum activity is being practised ranges from landslides, debri flow, mudflow, flash floods, land slides dammed floods. Therefore, selecting a model rehabilitation package within an altitudinal range of 1500 to 2400 m would be highly appropriate and effective not only from technical point of view but also from the jhum rehabilitation aspect.

2 Physiographic features and natural resources

Overview[1]

The State of Arunachal Pradesh covers a geographical area of 86,743 Sq. Km. and accounts for about 2.55% of the total area of the country (32.88 lakhs Sq.Km.) The state is bounded by China (Tibet) in the north, Myanmar in the East and Bhutan in the west. It has a common border with Nagaland in the East and South-East and Assam in the south.

The state is endowed with rich natural resources like forests and water wealth in its numerous rivers and streams. The vegetative cover of the state has been thinned out in number of places due to natural disaster, deforestation for various requirements to meet the need of growing population, etc. Out of total geographical area of 83,743 Sq. km. of the state nearly 51,540 Sq. km.(62%) has been reported to be under forest cover.

The Per Capita Income of the state for the year 1999-200 (Q) was estimated at Rs.14338 at current prices and Rs. 9170 at constant prices (base yr 1993-94) and the corresponding figures for the year 1998-99 (P) were Rs. 12335 and Rs. 8401 respectively. The per capita income also rose by 16.24 % at current prices and 9.15% at constant prices over the figures of preceding year 1998-99 (P). The quick estimates at current prices during 1999-2000 indicates increasing economic trend by 19.1% over previous year 1998-99 (P).

The economy of the state is largely agrarian, and agriculture occupies the most dominant position in the economy. Agriculture provides direct employment to about 67% of the total main workers of the state. Agriculture in the state is mainly depend on monsoons. The varied agro-climatic condition in the state is conducive to horticulture, and nearly 41601 hac. of area was brought under fruit plants which indicates 19.48% increase in area coverage as compared with previous year 1998-99. During 1999-2000, the horticultural crop production was 107093 Mt. as against 93582 Mt. in 1998-99.

By electrifying 2381 villages out of 2649 village as per 1991 census Nearly 65% of the villages in the state have been covered under rural electrification up to the end of March, 2000. The installed capacity of power in state stood at 31.83 MW for hydel power and 35.000 MW from Diesel set during 1999-2000. The overall power supply position in the state is inadequate to meet the growing requirement.

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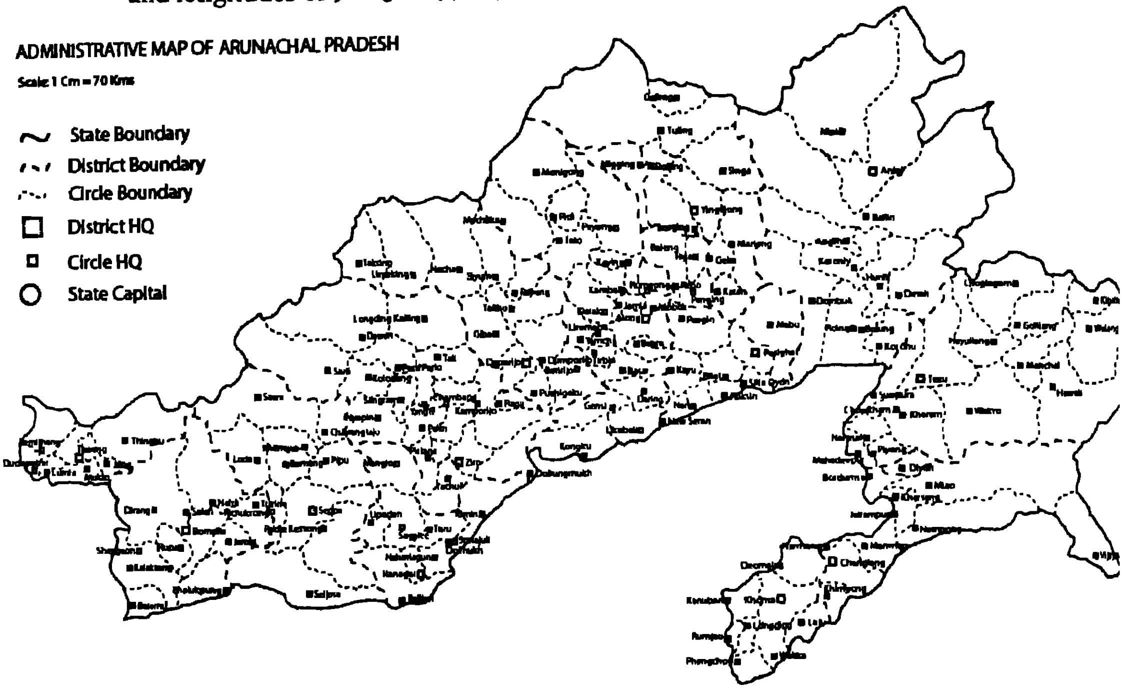
[1] Economic review of Arunachal Pradesh, 2000

Inadequacy of infrastructural facilities like road, power, institutional finance etc. has stood as hindrances to accelerate the process of industrialisation in the state.

Administrative set-up

The state of Arunachal Pradesh is situated between latitudes of 26°30' to 29°28'N and longitudes of 91°25' to 97°24' East. The state of Arunachal Pradesh has been divided into 13 districts, 36 sub-division, 55 Block and 148 circles respectively (Table 2.1). An administrative map of Arunachal Pradesh presented in figure 2.1, and a detail administrative break-up is presented in Annex I.



Source: Directorate of census operations, Arunachal Pradesh

Table 2.1. Administrative set up in Arunachal Pradesh

Districts.	Number of Sub-Divisions	Number of Blocks	Number of Circle
Tawang	2	3	6
West Kameng	3	3	8
East Kameng	2	4	11
Papumpare	2	2	10
Lowre Subansin	2	9	16
Upper Subansiri	2	4	11
West Siang	6	7	19
East Siang	4	4	12
Upper Siang	3	4	10
Dibang Valley	3	3	10
Lohit District	3	5	14
Changlang	2	4	11
Tirap	2	3	8

Source Directorate of Economics and Statistics, 2001

Distribution of Land use and Land cover changes

Land management and land-use dynamics are major determinants of land cover changes. Land-use patterns are the result of interactions among human demands, resultant ecological constraints, change in land cover, and the integration of systems across the scales. Distribution of wasteland under various categories is presented in table 2. 2 district wise break up of land use and land cover in Arunachal Pradesh is presented in Annex II.

Table 2.2 Land use pattern in Arunachal Pradesh

Land category	Total area available. In sq km	% of total geographical area
Total geographical area	83743	100%
Gullied land	0.0	0.0
Land without scrub	3326.78	3.97
Waterlogged land	41.47	0.05
Saline land	0.0	0.0
Jhum land	3088.08	3.69
Forest waste land	1416.67	1.69
Grazing land	2134.99	2.55
Plantation crop land	6.07	0.007
Costal/ sands	309 43	0.37
Mining waste land	0.30	0.0004
Barren/rocky area	1262.36	1.51
Steep sloping area	7.95	0.009
Snow area	6732.17	8.039

Source: 1:50 000 Scale wasteland maps prepared from Landsat Thematic Mapper/ IRS/LISS II/III data. Wasteland Atlas of India, 2000

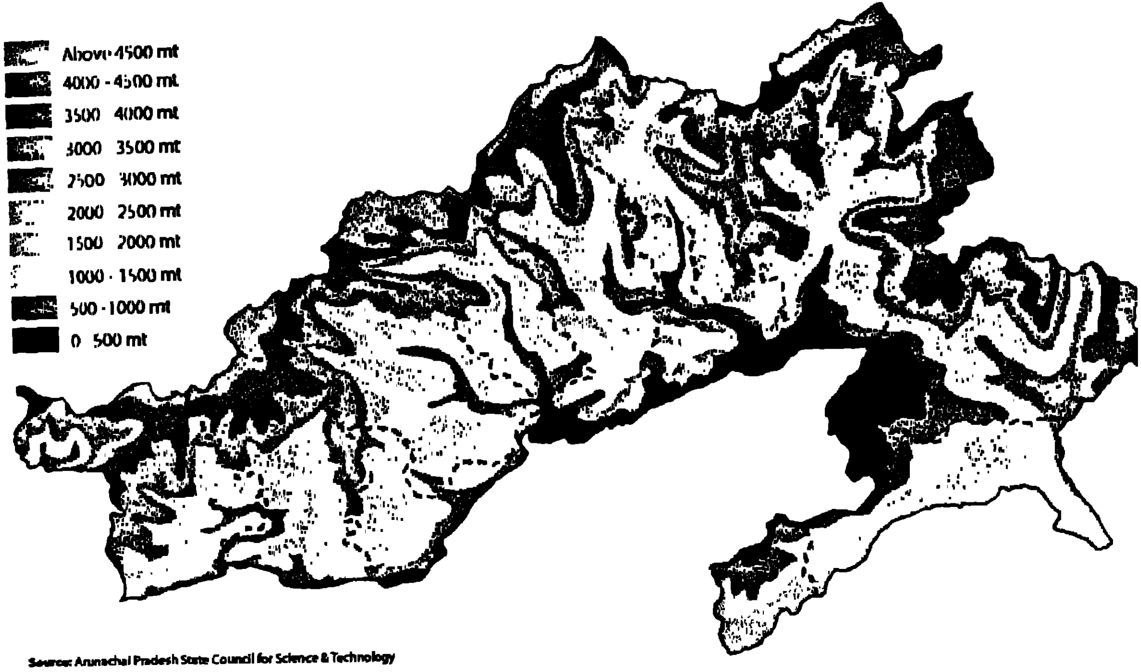
Physiographic features and natural resources

Physiography

Arunachal Pradesh Himalayas extends in north-easterly direction through the districts of Kameng, Subansiri and Siang and further east, beyond river Siang, where it takes an orographic swerve to the south in Lohit district and in the eastern part of Tirap district. In Tirap district the Naga Hill trending NE-SW abut against the Himalayas. The sub-Himalayan ranges (up to about 1, 700 m. altitude) and lower Himalayas ranges (up to about 3,500 m. altitude), culminate into the Greater Himalayas with important peaks like Gorichen (6,538 m) and Kongtu (7,090 m) exceeding 4,500 m in altitude.

The Greater Himalayas with its snow capped mountains include the northern parts of the Lohit, Dibang valley, East and West Siang, Lower and Upper Subansiri, East and West Kameng districts. The area is characterised by very rugged topography with steep and highly dissected slopes. The major rivers like Tenga, Bichom, Subansari, Siang and Lohit originate in these ranges and flow into the plains of Assam Valley through central and sub-Himalayan ranges.

Plate - 1 CONTOUR MAP OF ARUNACHAL PRADESH
Scale 1 cm = 70 Kms



Source: Arunachal Pradesh State Council for Science & Technology

Geology

The erstwhile Assam Himalaya known earlier in different segments as Aka Hills, Daphala hills, Miri hills, etc. now form the territory of Arunachal Pradesh. Unlike western Himalayas, the Arunachal Pradesh Himalayas has not been mapped entirely, due problem s of logistics, movement and inter-communicational facilities. About 5, 554 sq. km. of the area has been geologically traversed and mapped on different scales. However since the geological information from various parts of all the districts are available, it has been possible to identify the broad patterns in the stratigraphic, tectonic and geomorphic aspects.

The geology of the state is characterised by the presence of sedimentary and metamorphic rocks of various epochs. For descriptive convenience the litholostratigraphic succession and techtonic units that met with the lesser Himalayan zone are summarised for two different parts viz: (A) Kameng and Siang Himalayas and (B) Lohit Himalaya. The geology is characterised by the presence of sedimentary and metamorphic rocks of various epochs, starting form the ancient to the recent times. The geology of Tawang and Kameng indicate strong deformation (folding & faulting) which have brought the older system above the younger ones.

(A) Kameng and Siang Himalayas

Recent - sub recent		Alluvium and terrace deposit
Pleistocene		Ziro valley deposit: Younger parts of Dhing beds (eg. Deban beds) and uppermost Siwalik
Pliocene	Siwalik (Upper Unit)	Dihing Namsangs
		Unconformity
Miocene		Middle & Lower Siwalik units
		Unconformity
Oligocene to Pleistocene		kimi beds, sandstone & red shale, silty beds with black rock and chert fragments
Mesozoic		Basic trap rocks (lateritised) white quartzite
Permian	Gondwana	Sandstone, slates (with plant remains, e.g. *Glossoptens)*
Carboniferous to Permo-Carboniferous	Bichom Group	Marine ash green shales, calc-shales, etc. Boulder Slates and quartzites
		Unconformity
Silurian to Devonian ? Lower Carboniferous		Miri formation - varieagated slates with calc-beds Abor volcanics and pink and whitish quartzites
Lower Palaeozoic	Tenga formation	Bands of dolomite and carboniferous slates; whitish quartzite and conglomerate beds; hematitc phyllites and quartzites . Grey gritty and schistose phyllites with whitish quartzites intercalations , chlorite-Talc schist.
Early Plalaeozoic Precambrian	Bomdila Group	Dirang and other Schists (Kameng) Potin and Khetaban schist (Subansiri, Siang) Ziro, Chakko, Sepa, Daporizo, augen banded gnessis etc. (Palaeozoic gnessis of metasomatic nature ?)
Palaeozoic to Sela Group of Precambrian		Tourmaline granite (post -tectonic) Tertiary ? Schist, migmaties, lit par-lit gneisses ect.

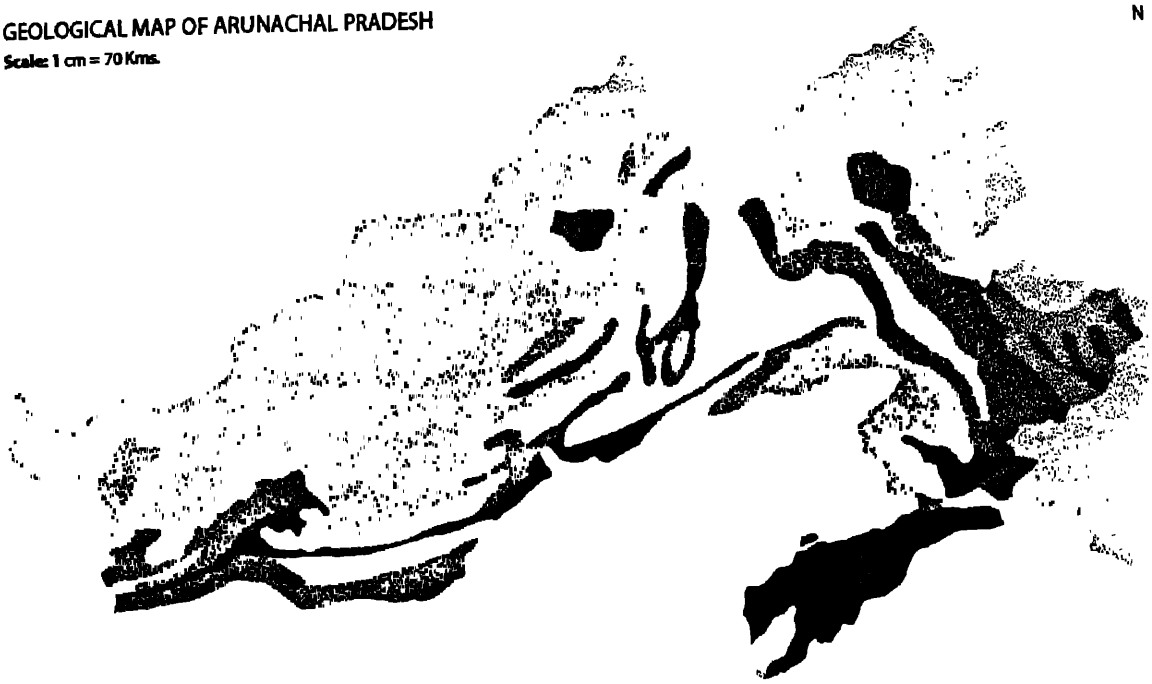
(B) Lohit Himalaya:

Plio -Pleistocene	Upper Siwaliks	Upper Tertiary rocks (Dhings)	
Miocene to Palaeocene	----	Not explored	
Mesozoic	------	Not explored	Covered in Lohit Plains
Upper Palaeozoic	----	Not explored	
Middle Palaeozoic	-----	Rocks of Miri formation (Dibang valley)	
Per-Permian	-----	Diorite -granodiorite complex - metasomatic & intrusive phases	
Lower to Middle Palaeozoic	Tenga Formation ? Miri Formation	Carbonates , Tezu & Tidding Limestone s etc. and quartzites Metasediments --- (flyish ?) and serpentine of Tidding and Tellu confluences area.	
Early Palaeozoic to Pre-cambrian	Bomdial Group	Para-guneisses, high and low grade schist (Pelllitc and graphitec) of Sewak Pass, Lalpani etc.	

Source . Geological Survey of India

GEOLOGICAL MAP OF ARUNACHAL PRADESH

Scale: 1 cm = 70 Kms.



Source: Geological Survey of India

▨	Alluvium	Recent
▨	Older Alluvium & River Terrace	Pleistocene
■	Dihing Series Dupitila Series	
▨	Undifferentiated Neogene & Pleistocene continental formations	Miocene Pleistocene
▨	Tipam Series & Chengapara formations (Garo Hills)	Pliocene
▨	Buxa Group, Bomdila Group	Upper Proterozoic
■	Jaintia Series, Disang Series	Eocene
▨	Undifferentiated Mesozoic tertiary formations	Mesozoic Paeleozoic
■	Lower Gondwana formations	Permian Carboniferous
·	Miri formations, Abor volcanics	Middle Paeleozoic
■	Barail Series & Simsung formation (Garo Hills)	Oligocene
▨	Gneisses with old inliers, Sela Group	Archaen - Middle Proterozoic
▨	Granodiorite, Diorite Gneisses basic dykes	Lower Paeleozoic
▨	Tenga formation, Tiding group Ophiolites	
■	Faults, Thrusts	
▨	Not Mapped	

Soil

Soil may be considered as the physical basis of life. For sustained utilization of the soil resources it is important to know the nature and characteristics and extent of distribution of different soil, their qualities, productive capacity and sustainability for alternate land use. The state of Arunachal Pradesh is endowed with a wide range of climate, physiography, geology and vegetation that influences the ecosystem resulting in the formation of different type of soil. The National Bureau of Soil Survey & Land use Planning (NBSS&LUP) has undertaken the soil resource mapping on 1:250,000 scale, where four different ecozones has been identified and detail characterises, area and distribution are enumerated are separate heads. The identified soil has been classified under the ecozones namely

- Soils of warm Per-humid, Eastern Himalaya Ecosystem
- Soil of warm Per-humid Siwalik hill ecosystem
- Soil of warm Per-humid, Purbanchal Ecosystem
- Soil of hot humid plain ecosystem (Brahmaputra valley)

Soils of warm Per-humid, Eastern Himalaya Ecosystem

The Soils of warm Per-humid, Eastern Himalaya Ecosystem ecozones constitutes the major areas of Arunachal Pradesh covering the district of Tawang, major part of East and West Kameng, Lower and Upper Subansiri, except southern part, East and West Siang, Dibang Valley and northern part of Lohit district. The region covers an area of 6.71 m ha representing 80.1 % of the total geographical area of the state.

Soil of warm Per-humid Siwalik hill ecosystem

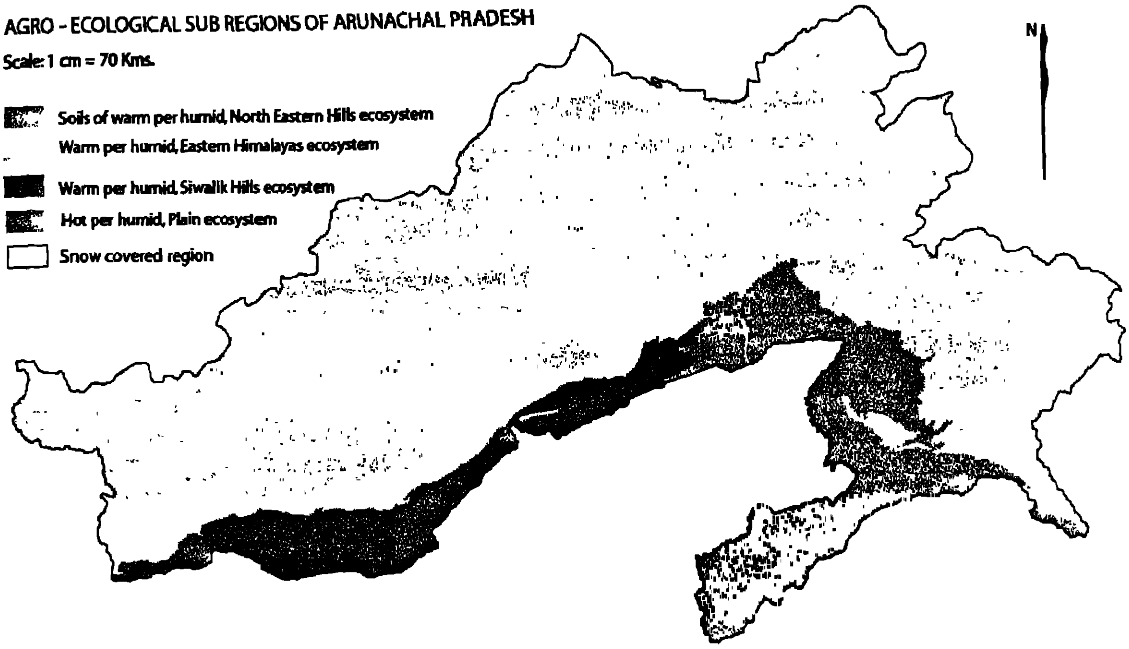
The ecozones cover an area comprising the southern part of West and East Kameng districts, lower and upper Subansiri and small part of West Siang district of the state. The region occupies an area of 0.62 m ha representing 7.4% of the total geographical area of the state.

Soils of warm Per-humid, Purbanchal Ecosystem

The ecozones comprise the North Eastern part of the state constituting the district of Tirap, Changlang, and part of Lohit district, covering an area of 0.44 m ha representing 5.3% of the total Geographical area of the state.

Soil of hot humid plain ecosystem (Brahmaputra valley)

The ecozones comprising the plains of the Brahmaputra river system which is the eastern continuity of Assam plains and covers parts of the districts like Lohit, Dibang valley, Tirap and East Siang of Arunachal Pradesh. The area occupied is 0.6 m ha, representing 7.1 % of the total geographical area of the state.


Soils of warm per humid, North Eastern Hills ecosystem
Warm per humid, Eastern Himalayas ecosystem
Warm per humid, Siwalik Hills ecosystem
Hot per humid, Plain ecosystem
Snow covered region
N

AGRO - ECOLOGICAL SUB REGIONS OF ARUNACHAL PRADESH
Scale: 1 cm = 70 Kms.

Source: National Bureau of Soil Survey & Land Use Planning (ICAR)

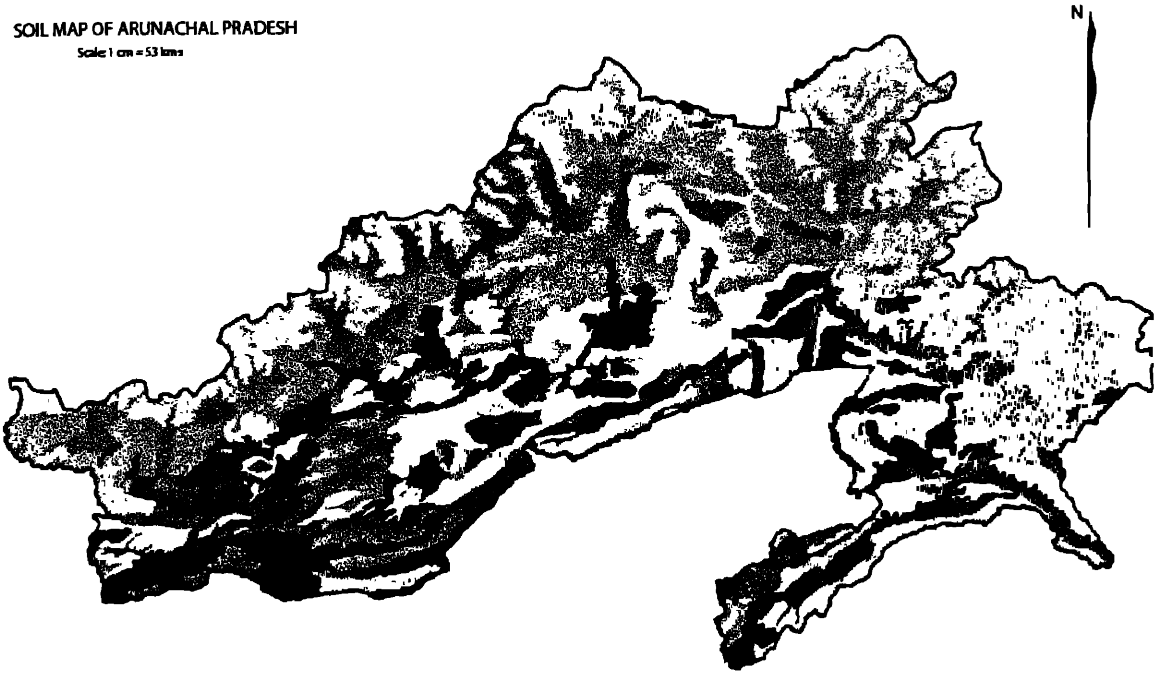
The farmer's field is an open system with much more potential for losses from crop removal, animal manure not returned to the agricultural fields, erosion, and leaching on the steep slopes results in nutrient mining. Therefore control of soil erosion and other improper land management practices is desired. Soil usually require rehabilitation before sustainable and economically rewarding agriculture can be practiced.

In most of the agricultural practices, nutrients are added to the field's nutrient bank by bringing nutrients in from sources outside the field or farm. Soil nutrient stocks can be replenished by adding the deficient mineral and by increasing the amount of crop residue and other organic materials returned to the soil. It is very important to identify where there is a need to import additional external nutrient inputs.

At the macro level, development of land resources to enhance agriculture and horticulture production making it an economically viable activity can be brought about through an "Agro-ecological Land Resources Assessment " considered with the land use potentials of land resources in each of the districts in Arunachal Pradesh. The information generated by NBSS&LUP on the scenarios for optimal land resources allocation is a tool for policy formulation and development planning. Detail information on soil types for the state of Arunachal Pradesh is presented in a map along with soil characterised, which can be the guiding principle for planning of agriculture and horticulture in the state.

SOIL MAP OF ARUNACHAL PRADESH

Scale 1 cm = 53 kms



Source: National Bureau of Soil Survey & Land Use Planning

SOILS OF SIWALIK HILLS

■	Deep, excessively drained, loamy skeletal soils on very steeply sloping summits having loamy surface with severe erosion hazard and strong stoniness: associated with; moderately deep, excessively drained, fine loamy soils with severe erosion hazard and slight stoniness.
▩	Very deep, well drained, fine loamy soils on moderately steeply sloping summits having loamy surface with moderate erosion hazard: associated with; deep, well drained, loamy skeletal soils with moderate erosion hazard and slight stoniness.
■	Deep, somewhat excessively drained, loamy skeletal soils on steeply sloping summits having loamy surface with severe erosion hazard and moderate stoniness: associated with; deep, somewhat excessively drained, fine loamy soils with moderate erosion and strong stoniness.
▨	Deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slopes of hills having loamy surface with severe erosion hazard and slight stoniness: associated with; deep, well drained, fine loamy soils on gently sloping foothill slopes with moderate erosion hazard and slight stoniness.
▩	Deep, somewhat excessively drained, fine loamy soils on steeply sloping side slopes of hills having loamy surface with severe erosion hazard and slight stoniness: associated with; deep, well drained, loamy skeletal soils on moderately sloping side slopes of hills having loamy surface with moderate erosion hazard and slight stoniness.
▩	Deep, somewhat excessively drained, loamy skeletal soils on moderately sloping side slopes of hills having loamy surface with severe erosion hazard and slight stoniness: associated with; very deep, well drained, fine loamy soils with moderate erosion hazard.
■	Deep, well drained, coarse loamy soils on gently sloping piedmont slopes having loamy surface with moderate erosion hazard and moderate stoniness: associated with; moderately deep, somewhat excessively drained, loamy skeletal soils on moderately sloping side slopes of hills with severe erosion hazard and moderate stoniness.

SOILS OF EASTERN HIMALAYAS

▨ Shallow, excessively drained, loamy skeletal soils on very steeply sloping hill summit having loamy surface with very severe erosion hazard and moderate stoniness: associated with; moderately deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slopes with severe erosion hazard and moderate stoniness.

▨ Deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping summits having loamy surface with severe erosion hazard and moderate stoniness: associated with; moderately shallow, excessively drained, sandy skeletal soils on steeply sloping summits with very severe erosion hazard and slight stoniness.

▨ Shallow, excessively drained, loamy skeletal soils on steeply sloping summits having loamy surface with severe erosion hazard and slight stoniness: associated with; moderately deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slopes and slight stoniness.

▨ Shallow, excessively drained, loamy skeletal soils on very steeply sloping summits having loamy surface with severe erosion hazard and strong stoniness: associated with; moderately deep, somewhat excessively drained, sandy skeletal soils with very severe erosion hazard and moderate stoniness.

▨ Very deep, well drained, fine soils on moderately steeply sloping side slope of hills having loamy surface with moderate erosion hazard and slight stoniness, associated with: Very deep, well drained, fine loamy soils on moderately steeply sloping side slope of hills with moderate erosion hazard.

□ Shallow, excessively drained, sandy skeletal soils on very steeply sloping side slopes of hills having loamy surface with severe erosion hazard and strong stoniness: associated with; moderately deep, excessively drained, loamy skeletal soils on steeply sloping side slope of hills with very severe erosion hazard and slight stoniness.

□ Very deep, somewhat excessively drained, fine soils on moderately steeply sloping side slope of hills having loamy surface with moderate erosion hazard: associated with; moderately shallow, excessively drained, clayey soils on steeply sloping side slope of hills with severe erosion hazard.

▨ Moderately shallow, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slope of hills having loamy surface with severe erosion hazard and strong stoniness, associated with; moderately deep, somewhat excessively drained, fine loamy soils with moderate erosion hazard.

▨ Deep, well drained, fine soils on moderately side slope of hills having clayey surface with moderate erosion hazard, associated with; very deep, well drained, fine loamy soils with moderate erosion hazard.

□ Very deep, somewhat excessively drained, fine loamy soils on moderately steeply sloping side slope of hill having loamy surface with moderate erosion hazard and slight stoniness: associated with; very deep, well drained, fine loamy soils with moderate erosion hazard.

■ Very deep, well drained, fine loamy fine soils on moderately sloping side slope of hills having loamy surface with moderate erosion hazard and slight stoniness: associated with, very deep, well drained, fine soils with moderate erosion hazard.

□ Very deep, well drained, fine soils on moderately steeply sloping side slope of hills having clayey surface with moderate erosion hazard: associated with; deep, somewhat excessively drained, fine soils with erosion hazard.

■ Very deep, poorly drained, fine soils on very gently sloping plain in narrow valley having loamy surface with slight erosion hazard and slight flood hazards: associated with; very deep, imperfectly drained, fine soils with slight erosion hazards.

■ Very deep, well drained, fine soils on moderately sloping side slopes of hills having loamy surface with moderate erosion hazard: associated with; deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slopes of hills having loamy surface with severe erosion hazard.

■ Very deep, well drained, fine soils on moderately steeply sloping side slopes of hills having loamy surface with moderate erosion hazard: associated with; deep well drained, fine soils on moderately steeply sloping side slopes of hills with severe erosion hazard.

■ Very deep, well drained, fine loamy soils on moderately sloping side slopes of dissected low hills having loamy surface with moderate erosion hazard: associated with; very deep, well drained, fine loamy soils with moderate erosion hazard.

SOILS OF NORTH EASTERN HILLS

▨	Very deep, well drained, fine soils on moderately sloping side slopes of hills having loamy surface with moderate erosion hazard: associated with; Very deep, well drained, fine soils with moderate erosion hazard.
■	Very deep, well drained, fine soils on moderately sloping side slopes of hills having clayey surface with moderate erosion hazard: associated with; deep, well drained, clayey skeletal soils with moderate erosion and slight stoniness.
■	Very deep, well drained, fine soils on moderately sloping side slopes of hills having clayey surface with moderate erosion hazard: associated with; deep, imperfectly drained, fine loamy soils on very gentle slopes of narrow valley with moderate erosion hazard.
░	Very deep, well drained, fine soils on moderately steeply sloping side slopes of hills having loamy surface with severe erosion hazard: associated with; Very deep, well drained, fine soils with moderate erosion hazard.
■	Very deep, well drained, fine soils on moderately steeply sloping side slopes of hills having clayey surface with moderate erosion: associated with; Very deep, well drained, fine soils on moderately sloping side slopes of hills with moderate erosion and slight stoniness.
■	Moderately deep, somewhat excessively drained, loamy skeletal soils on moderately steeply sloping side slopes of hills having loamy surface with severe erosion hazard and slight stoniness: associated with; deep, well drained, clayey skeletal soils with moderate erosion and moderate stoniness.
□	Moderately deep, well drained, fine soils on moderately sloping side slopes of hills having clayey surface with severe erosion and slight stoniness: associated with; moderately deep, well drained, fine loamy soils with moderate erosion hazard.
▨	Deep, well drained, loamy skeletal soils on moderately sloping side slopes of hills having loamy surface with severe erosion hazard and moderate stoniness: associated with; deep, well drained, fine loamy soils with moderate erosion hazard.
▨	Deep, well drained, loamy skeletal soils on moderately sloping side slopes of hills having loamy surface with severe erosion hazard and moderate stoniness: associated with; very deep, well drained, fine loamy soils with moderate erosion hazard.
■	Moderately deep, well drained, clayey skeletal soils on moderately sloping side slopes of hills having loamy surface with moderate erosion hazard: associated with; deep, well drained, fine soils with moderate erosion hazard and slight stoniness.
■	Deep, somewhat excessively drained, clayey skeletal soils on steeply sloping side slopes of hills having clayey surface with severe erosion hazard and moderate stoniness: associated with; deep, well drained, fine soils with moderate erosion and slight stoniness.
□	Shallow, excessively drained, loamy skeletal soils on very steeply sloping side slopes of hills having loamy surface with very severe erosion hazard and slight stoniness: associated with; moderately deep, somewhat excessively drained, loamy skeletal soils with severe erosion hazard and moderate stoniness.

SOILS OF PLAINS

☐	Moderately shallow, well drained, loamy skeletal soils on very gently sloping upper piedmonts having loamy surface with very severe erosion and slight flooding hazard: associated with; moderately deep, well drained, coarse loamy soils with moderate erosion hazard and slight stoniness.
■	Very deep, well drained, coarse loamy soils on very gently sloping upper piedmonts having loamy surface with moderate erosion and slight stoniness: associated with; deep, well drained, coarse loamy soils with severe erosion and slight flooding hazard.
▨	Very deep, well drained, fine soils on very gently sloping upland having loamy surface with very moderate erosion and slight flooding hazard: associated with; very deep, well drained, fine soils on gently sloping uplands with moderate erosion hazard.
☐	Very deep, well drained, fine soils on very gently sloping upland having loamy surface with moderate erosion hazard: associated with; deep, well drained, clayey skeletal soils with moderate erosion hazard and slight stoniness.
☐	Very deep, well drained, fine loamy soils on very gently sloping plain having loamy surface with moderate erosion hazard: associated with; very deep, moderately well drained, fine loamy soils with moderate erosion and slight flooding hazard.
■	Very deep, imperfectly drained, coarse loamy soils on level to nearly level plain having loamy surface with slight erosion and moderate flooding hazard: associated with; very deep, imperfectly drained, fine silty soils with slight erosion and moderate flooding hazard.
☐	Very deep, moderately well drained, coarse loamy soils on very gently sloping flood plain having loamy surface with severe erosion and severe flooding hazard: associated with; deep, well drained, coarse loamy soils with moderate erosion and moderate flooding hazard.
☐	Deep, well drained, coarse loamy soils on very gently sloping active flood plain having sandy surface with very severe erosion and very severe flooding hazard: associated with; moderately deep, somewhat excessively drained, sandy soils with moderate erosion and severe flooding hazards.
▨	Deep, imperfectly drained, coarse silty soils on very gently sloping active flood plain having loamy surface with severe erosion and severe flooding hazard: associated with; very deep, moderately well drained, coarse loamy soils with moderate erosion and flooding hazards.
■	Moderately shallow, somewhat excessively drained, sandy soils on very gently sloping bar lands having sandy surface with very severe erosion and flooding hazards.
▨	Rocky mountains covered with perpetual snow and glaciers.

Water resource

Water is vital for realising the full potential of the agriculture sector. Optimum development and efficient utilization of the water resources therefore assumes great significance. The Ministry of Water Resources lays down policies and programmes for the development and regulation of the country's water resources. It covers sectoral planning, coordination, policy guidelines, technical examination and techno-economic appraisal of projects, providing Central assistance to specific projects, facilitation of external assistance and assistance in resolution inter state disputes, policy formulation, planning and guidance in respect of minor irrigation, command area development and ground water resources, etc.

The national water Policy was adopted in September 1997 and since then a number of problems and challenges has emerged in the development and management of the water resources sector. Accordingly, the National Water Board in its meeting on 29.10.1998 reviewed the existing National Water Policy 1987, considered proposed changes and finalised the updated draft National Water Policy.

The two main sources of water in the state are rainfall and the snowmelt of glaciers in the Arunachal Pradesh Himalayas, resulting in surface flow and base flow simultaneously replenishing the groundwater reserves. The trends for ground water level in the valley areas of the state revealed from measurements of depth to ground water level and its fluctuations in the network stations during post monsoon and pre-monsoon for the last ten years (1992-2001) seems to be stable and there is no rise and fall in any part of the state (CGWB). The depth to water level is reported to be 2.0 m to 10.0 m and water level fluctuation ranges from 1.0 m to 4.0 m. Analysis of ground water samples from the hydrograph network station indicate the quality of the water to be good for domestic as well as industrial and agricultural use. No toxic element has been reported so far from any part of the state. The water bearing formation are the unconsolidated formation of quaternary age, followed by primary / secondary porosity of semi-consolidated sandstone of tertiary age and secondary porosity of granites, schist, gnesii, phyllites of Archean to Precambrian age. The transmissibility rate in the aquifer ranges from 1.14 to 6661.4 m^3/day. The discharge rate from exploratory wells ranges from 1.36 m^3/h to 53.58 m^3/h (Central Ground Water Board). A water resource assessment for the state is presented in table 2.3.

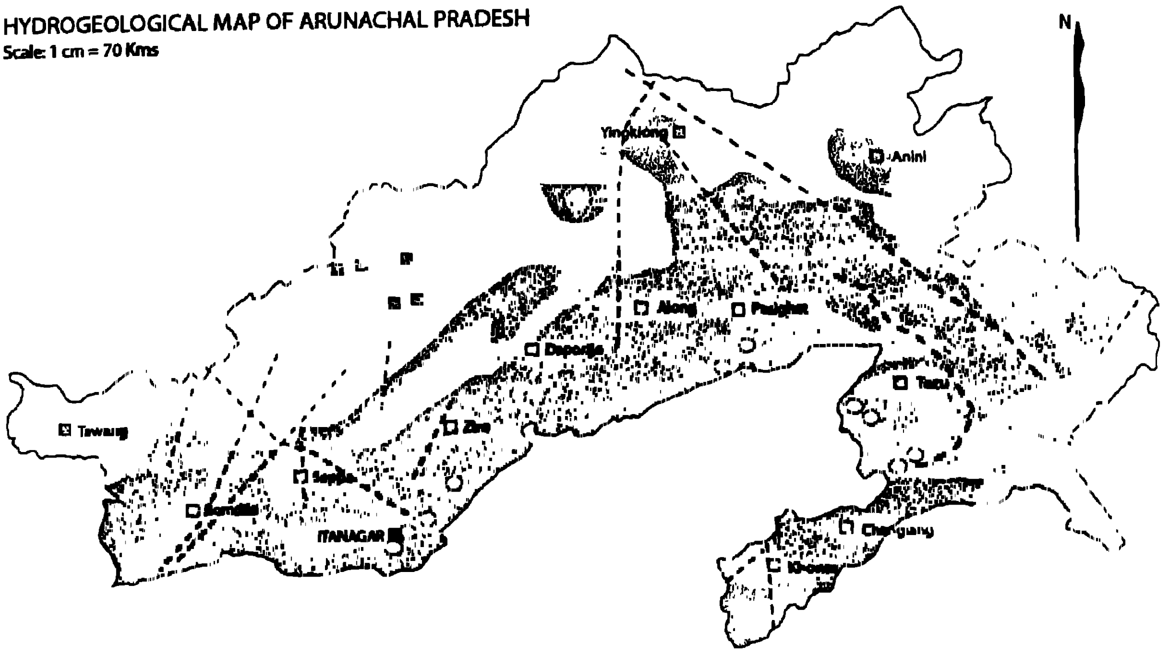
Table 2.3 Ground water Resources and irrigation potential in Arunachal Pradesh

Total replineshable Groundwater resource m.ha.m/y	Provision for domestic, Industrial and other use m.ha.m/y	Available groundwater resource for irrigation in net terms m.ha.m/y	Utilisable groundwater resource for irrigation in net terms m.ha.m/y	Net draft m.ha.m/y	Balance ground water resource for future use in net terms m.ha.m/y	Utilisable irrigation potential for development m.ha
0.14385	0.02158	0.12227	0.11005	-	0.12227	0.01800

Source: Ministry of water Resources, Government of India

HYDROGEOLOGICAL MAP OF ARUNACHAL PRADESH

Scale: 1 cm = 70 Kms



Source: Central Groundwater Board, North East Region, 2002-2003

AQUIFER CHARACTERS		LITHOLOGY	GROUNDWATER POTENTIAL
Porous Formation (Unconsolidated to Semi-consolidated)			
▩	Limited area with fairly thick and extensive unconfined to semiconfined aquifers. Highly permeable bouldery formation with sand, occassionally clay matrix. Bhabar & Tarai zones along foothills.	Recent, older alluvial & high level terraces - Clay, silt, gravel, pebble, cabble & boulders.	Mediun yield prospect 30 - 50 cubic mt. per hr. Drawdown 10 - 25 mt.
▨	Moderately thick but continous confined to unconfined aquifers within 100 mt. depth.		
▨	Fairly thick sandstones, soft with layers & pockets of peebles & clay.	Mattied clay, sandstone with peebles & conglomerate.	
■	Thick but discontinous, confined to semiconfined aquifers under bouldery conditions down to 200 mt. Scope for ground water development limited to synclinal tectonic & intermontane valleys.	Shale, siltstone, sandstone interbedded with coal seams, limestone.	Low yield prospect, upto 20 cubic mt. per hr. Drawdown with 25 mt.
Fissured Formation			
▨	Local discontinous, unconfined to semiconfined auifers. Groundwate restricted to 50 mt. depth in weathered residium and fissured formation.	Phyllites, schials, slates & quartzites.	Yield prospect 5-15 cubic mt. per hr.
░	Local, discontbous, unconfined to semiconfined aquifers down to 50 mt. depth in weathered mantle & fractures.	Gneiss, complex with acidic & basic intrusives.	Yield prospect upto 5 cubic mt. per hr.

TECTONIC FEATURES

■	National Hydrograph Met Workstation
■	Hot Water Spring
○	Exploratory Tube Well
- - -	Intermediate Lineament
- - -	Overthrust and Nappe

Vegetation types

Arunachal Pradesh is situated in the extreme corner of the north-eastern India holding major part of eastern Himalayas. The state has wide range of altitude, topography, soil types and agroclimate that nourishes a diverse of flora and fauna thus recognised one of the biodiversity hotspot of the world. The agroclimate of the state ranges from tropical to alpine. Researchers have classified the vegetation of the state in different forest types based on species composition, altitude and agroclimatic conditions (Rao 1972, Rao 1974, Kaul and Haridasan 1987[1], Champion and Seth 1978, Haridasan, Chauhan and Beniwal 1993.). The following classification of forest types are based on Kaul and Haridasan (1987).

Tropical forest (< 900 m msl)

The vegetation below 900 m msl has been categorised under tropical forest types. Tropical forest is composed of various trees, bamboos, canes, medicinal plants and other economically important plants. The dominant timber species are *Terminalia myriocarpa, Duabanga grandiflora, Dipterocarpus macrocarpus, Shorea assamica, Gmelina arborea, Mesua ferrea, Artocarpus chaplasha, Bombax ceiba, Canarium strictum, Michelia champaca.* The bamboo species include *Bambusa pallida, Dendrocalamus hamiltonii, Pseudostachyum polymorphum*, etc. Cane species are *Calamus tenuis, Calamus flagellum, C. floribundus, C. erectus, Daemonorops jenkinsianus, Plectocomia himalayana*, including 15 other species. Among the medicinal plants the dominants are *Terminalia chebula, T. bellirica, Emblica officinalis, Oroxylum indicum, Acorus calamus, Piper mullesua, Clerodendrum colebrookianum, Costus speciosus, Abroma augusta, Paedaria foetida* and numerous other species. Edible plants and fodder of this forest include *Spilanthes paniculata, Diplazium esculentum, Solanum nigrum, Sarcochlamys pulcherrima, Elaeocarpus floribundus, Baccaurea sapida, Garcinia pedunculata, Bauhinia purpurea*, etc. (Haridasan, Bhuyan and Deori, 1990). Other economically important non timber forest produce (NTFP) yielding species include gums and resins *from Canarium strictum, Shorea assamica, Cordia dichotoma*, etc. Bark of Jigat (Persea) for agarbathi manufacture, *Trema orientalis* and *Sterculia* for fibre, *Imperata* for thatch, *Thysonolaena* for broom, *Livistona* and *Calamus erectus* for roofing leaves, *Phrynium pubinerve* for leaf plates, *Musa* etc. for leaf and fibre.

Subtropical forests (900-1800m msl)

The vegetation ranging in 900m-1800m msl has been classified under sub tropical forest. The dominant tree species include *Michelia spp., Magnolia sp., Castanopsis, Quercus, Photinia, Albizia*, etc. bamboo species include *Cephalostachyum* *fuchsianum, Chemonobambusa callosa, Schizostachyum helferii, Phyllostachys bambusoides, Dendrocalamus sahnii*, etc. cane species include *Calamus innermis, Plectocomia himalayana.* Economically important NTFP yields fats, gums and resins include *Pinus roxburghii, Madhuca butyraceoides, Lindera sp.* etc. edible plant include *Zanthoxylum, Castanopsis, Solanum, Rubus*, etc.

Sub tropical pine forest

The sub tropical pine forest in contrast to the preceding forest has less biodiversity and has simple structure. These forests are in fact successional in nature and are met with in areas of scanty rainfall. Many useful commodities are available from these forests, including pine resins, pine timber, medicinal plants like *Rubia cordifolia, Solanum, Swertia, Berberis, Rhus*, etc. Aromatic plants like *Zanthoxylum* also grow here.

Temperate forests (1800-3500 m msl)

The altitude ranging from 1800 – 3500 m msL, in the hills of Arunachal Pradesh, luxuriantly grow the temperate forests of broad leafed or conifer type. Medicinal herbs and tree species are naturalized luxuriantly in this forest include *Ginseng, Illicium, Codonopsis, Rubia, Valeriana, Coptis teeta, Podophyllum, Taxus, Berberis*, etc. Main timber species are *Cupressus, Abies, Tsuga, oaks* and *laurels.* Some wild edible plants like *Myrica, Rubus, Prunus*, etc. are available in these forests.

Alpine forests (> 3500 m msl)

Beyond 3500 m MSL in Arunachal Pradesh, the agroclimate is characterised with severe cold, snow snowfall leaving harsh habitat for plants to grow. As a result, the forest has been reduced to the mere scrubs and grasslands. These meadows are the habitat for a great variety of medicinal and aromatic plants. Prominent among them are *Rhododendron anthopogon, Fritillaria, Aconitum, Hypericum Swertia, Gentiana, Juniper, Helinia, Valeriana, Bergenia, Gymnadaenia, Picrorrhiza* and others. There are a few lichens and mushrooms that are also gathered by the people for different purposes.

Secondary types

In addition to these broad categories, there are a few secondary types resulting from various biotic factors. The age old shifting agriculture, various developmental activities, extraction of timber and other commodities to destruction of primary vegetation and the resultant vegetation emerged as secondary types. The main categories under this are grasslands and bamboo breaks or degraded forests.

3

Status of Jhum cultivation in Arunachal Pradesh

Jhum Agriculture and Indigenous Knowledge in the Eastern Himalayas

Jhum cultivation, also known as Sweden or shifting cultivation (locally as cheliang by the Mompa's) is practised by almost all the mountain farming groups of Arunachal Pradesh in the Eastern Himalayas as a traditional knowledge system. Shifting cultivation has developed and existed in this region for thousands of years, as an indigenous life-supporting system that has acclimatizes with the location specific agricultural practices and life of the shifting cultivators.

Indigenous mountain communities have developed highly adaptable strategies which has lead to the development of specific knowledge of their local vegetation, flora and fauna in the surrounding environment, where Jhum fields and fallow fields are directly under the management of the Jhuming communities.

Thus indigenous knowledge on traditional agricultural and traditional land-use management practises on which Jhum cultivation is based can be utilised to the fullest extent in enhancing the crop productivity and preservation of the mountain ecosystems. Besides an in-depth study on Jhum cultivation, as an indigenous knowledge system in this region requires to be explored to the fullest extent possible. This relates to identification of crops, productivity under traditional crop combinations, pest and nutrient management, economics, etc. Thus with a detail understanding of the Jhum parameters, rehabilitation packages can be a useful component of rural development and environmental management in the Eastern Himalayas and for that of the Arakan Yoma belt.

Case studies have shown that swidden communities in the mountain areas have a rich and reliable traditional knowledge system for operating as well as adjusting to their substantial life support systems. Examples of such, e.g., sustainable upland rice and the rattan swidden system, known as dongya in the Hani group of southwest Yunnan, China; the inter-cropping systems of Alnus nepalensis and Cardamom plants established on swidden fields in the Sikkim Himalayas; and the talun-kebun system of bamboo planting with interplantation of vegetable/fruit trees/pulses, a modified shifting cultivation system in West Java. From swidden agriculture has evolved a large number of human uses for species of plants and wildlife in both swidden and fallow fields. In Yunnan, China, there are more than one hundred swidden crops; wild species used by humans in the swidden fields number more than five hundred. Some of these species are "specialised swidden crops" such as Job's tear, Coix lacrymajobi, in south and southeast Asia; the edible tuber legume, Moghania vestita, or Sophlong as it is known locally by the Khasi and Jaintia people in North East India, and the flea-grass, Adenosma buchnoroides, a herbal medicine grown by the Hani swiddeners in Yunnan, China. Measures to conserve crop-genetic diversity will have to take into account these swidden crops, varieties, and indigenous knowledge about using and preserving these biological species with swidden agriculture[1].

Distribution of Land use and Land cover changes

Land management and land-use dynamics are a major determinant of land cover changes. Land-use patterns are the result of interactions between human demands, resultant ecological constrains, change in land cover, and the integration of systems across the scales. Distribution of wasteland under various categories is presented in table 3.1. A district wise break up of land use and land cover in Arunachal Pradesh is presented in Annex II.

Table 3.1. Land use and Land cover in Arunachal Pradesh

Land category	Total area available. In sq kms	% of total geographical area
Total geographical area	83743	100%
Gullied land	0.0	0.0
Land without scrub	3326.78	3.97
Waterlogged land	41.47	0.05
Saline land	0.0	0.0
Jhum land	3088.08	3.69
Forest waste land	1416.67	1.69
Grazing land	2134.99	2.55
Plantation crop land	6.07	0.007
Costal/ sands	309.43	0.37
Mining waste land	0.30	0.0004
Barren/rocky area	1262.36	1.51
Steep sloping area	7.95	0.009
Snow area	6732.17	8.039

Source: 1:50 000 Scale wasteland maps prepared from Landsat Thematic Mapper/ IRS/LISS II/III data. Wasteland Atlas of India, 2000

Distribution of villages and area under Jhum

There are 3822 numbers of villages in the state, distributed across 56 blocks, where Jhum cultivation is under practised. A detail list of the villages under each district has been presented in Annex III. As Jhum cultivation is not a static activity therefore the area and length of the period under cultivation and the fallow period vary considerably. Under the present scenario the area under Jhum has been inferred based as per assessment made under the Wasteland Atlas of India, 2000. District wise population figures and household numbers have been tabulated for an estimation of the population pressure on Jhum in each district and is presented in table 3.2.

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[1] Indigenous Knowledge in the HKH, ICIMOD

Table 3.2 Distribution of villages and areas under Jhum in Arunachal Pradesh

Districts.	Number of villages	Rural Population	Urban Population	Area under Jhuming Sq. km
Tawang	224*	30249	4456	70.75
West Kameng	273*	67910	6685	523.48
East Kameng	280	42100	14965	283.96
Papumpare	263	59868	61882	279.63
Lower Subansiri	595	85325	12289	358.7
Upper Subansiri	409*	39527	15468	26.34
West Siang	406	82907	20668	199.28
East Siang	132*	65458	21972	19.23
Upper Siang	72	33146	-	70.77
Dibang Valley	238	47437	10106	121.3
Lohit District	489	116882	26596	34.28
Changlang	285	112682	12312	1100.4
Tirap	157	84938	15289	

Source: Directorate of Economics and Statistics, 2001 1:50 000 Scale wasteland maps prepared from Landsat Thematic Mapper/ IRS/LISS II/III data.

*Total number of village inclusive of hamlets

Area under Jhum. Wasteland Atlas of India, 2000

District wise population census as of 2001.

Horticultural trends for the last 10 years

Agriculture being the primary occupation in the state and with increased area under Jhuming activity with low returns in the long run, horticulture becomes a promotional activity under the present scenario. The Government of Arunachal Pradesh has been carrying out promotional activities of horticultural crops since its inception. Further focus on the horticultural sector would be ideal with a detail analysis of the existing crops and their performance for the last 10 years together with farmers' acceptability. As the response of crop productivity is intricately related to the microclimate influences and the state of Arunachal Pradesh being widespread, a detail district wise analysis of the crops trends has been essential. The approach undertaken has been related to crop productivity for crop performances under various microclimate and area expansion for farmers' acceptability and suitability of Government schemes.

Crop performance (Productivity)

More than 27 horticultural crops are grown mostly fruit bearing, rhizome/tuber yielding, aromatic and medicinal plants in Arunachal Pradesh. The crop production ranking during the year 1999 – 2000 is from pineapple (31980 t), followed by banana (12270 t), citrus (11315 t), apples (8265 t), pear (2837 t), papaya (2797 t), guava (2781 t), plum (2769 t), peach (1126 t), pomegranate (214 t), litchi (214 t), walnut (50 t), grape (7 t), kiwi (1 t), etc. respectively.

Analyses of individual crop productivity for the last ten years (from 1990-1991 to 1999-2000) are presented below. A detail table on the production for the state and the districts are presented in Annex – IV.

Apple: Productivity ranges from 1.25 to 3.44 t/ha. An average higher productivity was maintained during the year 1994- 95 (2.18 t/ha), 1995-96 (3.44 t/ha), 1996-97 (2.39 t/ha) and 1997-98 (2.47 t/ha). Since 1998-99 the productivity level has been exhibiting a declining trend. The present productivity is 1.25 t/ha).

Plum: Productivity ranges from 2.08 to 4.45 t/ha. The highest productivity was achieved in the year 1996 – 97 (4.45 t/ha). An increasing trend has been reflected for the last ten years. The present productivity is 3.44 t/ha).

Walnut: Productivity ranges from 0.02 – 2.04 t/ha. The highest productivity was achieved in the year 1998 – 99 (2.04 t/ha). A fluctuating trend has been reflected for the last ten years. The present productivity is 0.02 t/ha).

Citrus: Productivity ranges from 1.67 to 5.58 t/ha. The highest productivity was achieved in the year 1996 – 97 (5.58 t/ha). Thereafter a declining trend has been reflected for the last four years. The present productivity is 1.49 t/ha).

Guava: Productivity ranges from 2.06 to 2.88 t/ha. An increasing trend has been reflected for the last ten years. The present productivity is 2.88 t/ha).

Pomegranate: Productivity ranges from 0.92 to 1.47 t/ha. An increasing trend has been reflected for the last ten years. The present productivity is 1.47 t/ha).

Peach: Productivity ranges from 2.23 to 4.71 t/ha. An increasing trend has been reflected for the last ten years. The present productivity is 4.71 t/ha).

Pear: Productivity ranges from 2.72 to 5.58 t/ha. The highest productivity was achieved in the year 1996 – 97 (5.58 t/ha). An increasing trend has been reflected for the last ten years. The present productivity is 3.34 t/ha).

Grape: Productivity ranges from 0.58 to 1.0 t/ha. The highest productivity was achieved during the year 1993 – 97 (1.0 t/ha). A declining trend has been reflected for the last ten years. The present productivity is 0.64 t/ha).

Pineapple: Productivity ranges from 2.54 – 4.75 t/ha. The highest productivity was achieved in the year 1990 – 91 (4.75 t/ha). An increasing trend has been reflected for the last ten years. The present productivity is 4.37 t/ha).

Banana: Productivity ranges from 2.51 to 5.52 t/ha. The highest productivity was achieved in the year 1990 – 91 (5.52 t/ha). An increasing trend has been reflected for the last ten years. The present productivity is 4.78 t/ha).

Papaya: Productivity ranges from 2.08 to 4.45 t/ha. The highest productivity was achieved in the year 1996 – 97 (4.45 t/ha). An increasing trend has been reflected for the last ten years. The present productivity is 4.78 t/ha).

Kiwi: Kiwi is a newly introduced crop and hence only two years productivity 1992-93 (1.36 t/ha) and 1999 –2000 (0.045 t/ha) is available.

Litchi: Productivity ranges from 0.33 to 1.67 t/ha. The highest productivity was achieved in the year 1992 – 93 (1.67 t/ha). A declining trend has been reflected for the last ten years. The present productivity is 0.33 t/ha).

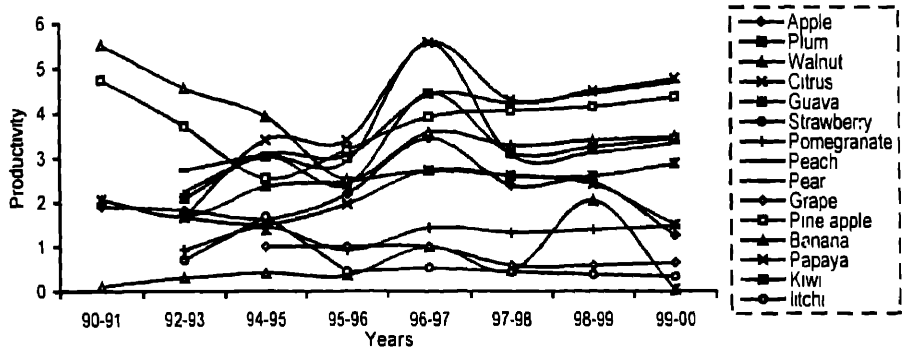


Fig 1. Productivity trend of horticultural crops for 1990 - 2000s

Farmers acceptability (Area expansion) in Arunachal Pradesh

Area expansion under horticultural crops is largely influenced by the acceptability of the farmers of the particular crop and the schemes under promotion. Crop wise area expansion for the last 10 years (1990 – 2000) has been analysed (State and Districts) and tabulated in Annex V.

The crop wise acceptability trend for the last 10 years as follows with reference to 1990 - 1991 as the reference baseline.

Apples: The total area expansion has increased from 4901 ha to 6600 ha.

Plum: The total area expansion has increased from 580 ha (1992-93) to 804 ha.

Walnut: The total area expansion has increased from 1046 ha to 2199 ha. However during the year 1998 – 99 there has been an increased in an area of 5768 ha.

Citrus: The total area expansion has increased from 5509 ha (1992-93) to 7593 ha.

Guava: The total area expansion has increased from 677 ha to 964 ha.

Pomegranate: The total area under cultivation has decreased from 220 ha (1992-93) to 146 ha.

Peach: The total area under cultivation has decreased from 440 ha (1992-93) to 239 ha.

Pear: The total area under cultivation has increased from 776 ha (1992-93) to 850 ha.

Grape: The total area under cultivation has decreased from 12 ha (1994-95) to 11 ha. During the year 1995 –97, there has been a drop in the area of cultivation to 6 ha.

Pineapple: The total area under cultivation has increased from 2871 ha to 7314 ha.

Banana: The total area under cultivation n has increased from 1520 ha to 3529 ha.

Papaya: The total area under cultivation has increased from 557 ha (1992-93) to585 ha. During 1996-97 there has been a drop in cultivation area to 422 ha.

Kiwi: The total area under cultivation has decreased from 751 ha (1994-95) to 25 ha. Data not available from 1995 to 1997 and from 1998-99.

Litchi: The total area under cultivation has increased from 363 ha (1992-93) to 639 ha. During 1994 – 95 there has been a drop in the cultivation area to 230 ha.

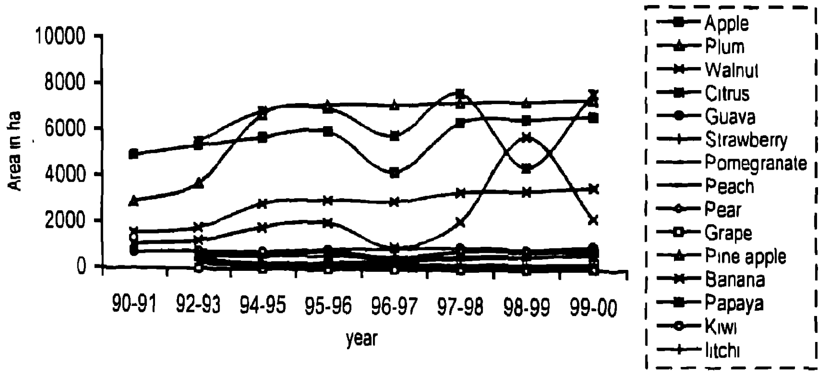


Fig 2s. Area trend of horticultural crops for 1990 - 2000s

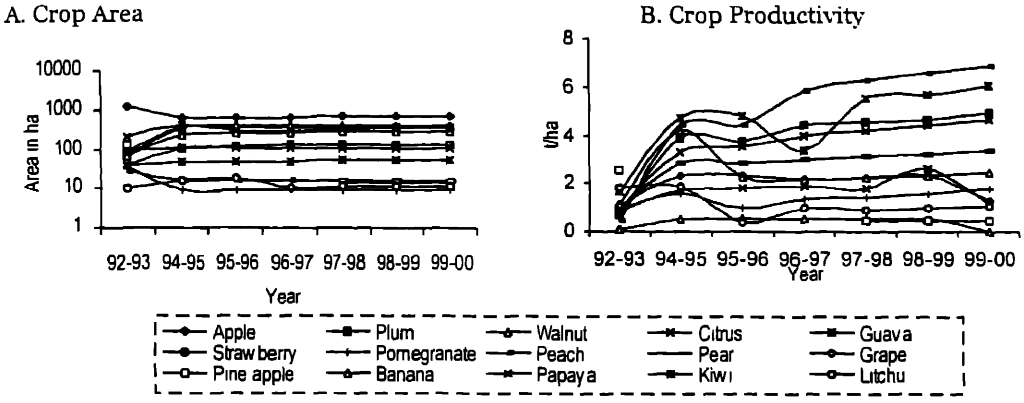
District wise performance of major horticultural crops and farmers acceptability

In order to understand the performance of the horticultural crops in each district in relation to productivity and area expansion, a detailed analysis is attempted and described as follows:

Lower Subansiri district:

Area expansion; Initial fall in area expansion followed by steady state for apple and plum whereas for walnut, citrus, guava, pear, banana, papaya it followed increasing trend. Pomegranate, peach, litchi remains in stagnation.

Productivity: Increasing trend for plum, guava, pomegranate, pear, peach, banana, papaya, litchi. Decreasing productivity; apple, walnut, citrus, pineapple.

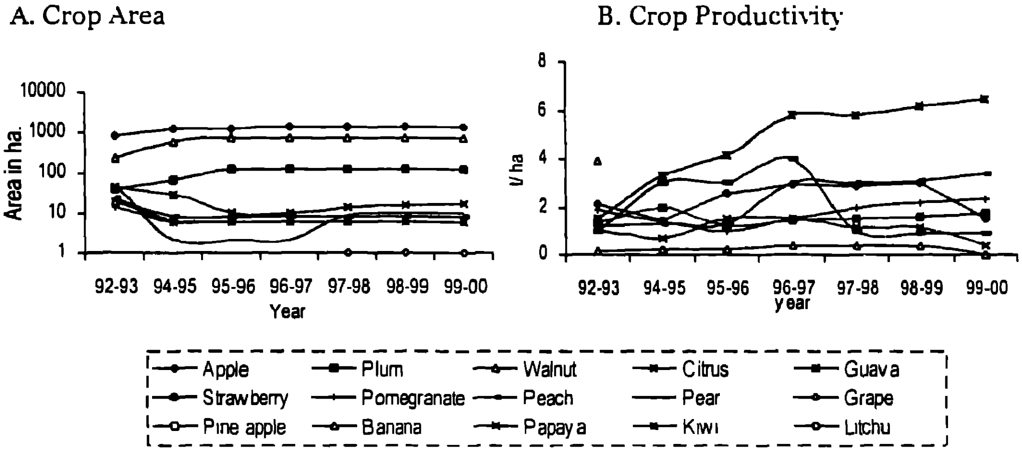

A. Crop Area

B. Crop Productivity

Tawang district:

Area expansion for apple, plum, walnut and citrus followed in increasing trend, whereas decreasing trend was observed for guava, pomegranate, peach, grape and pear.

Productivity for apple, plum, walnut., guava, pomegranate, peach followed increasing trend whereas decreasing trend for was observed for citrus and pear.

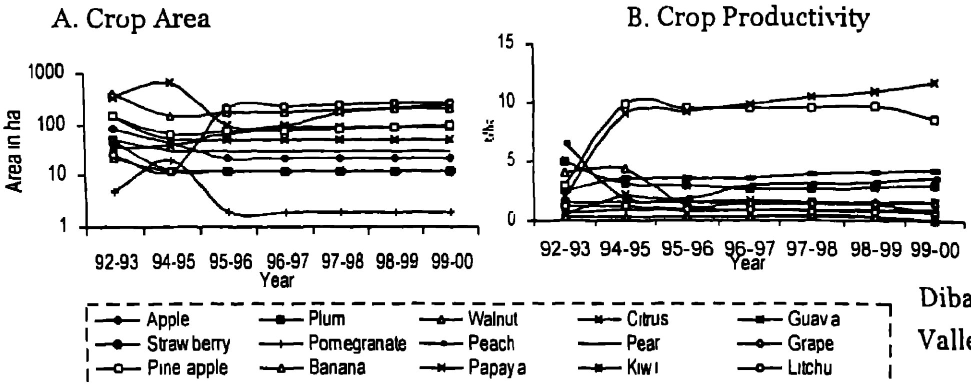

A. Crop Area

B. Crop Productivity

Lohit district:

Area expansion for plum, pear, grape, banana, papaya, litchi followed increasing trend whereas decreasing trend was observed for apple, walnut, citrus, guava, pomegranate and peach.

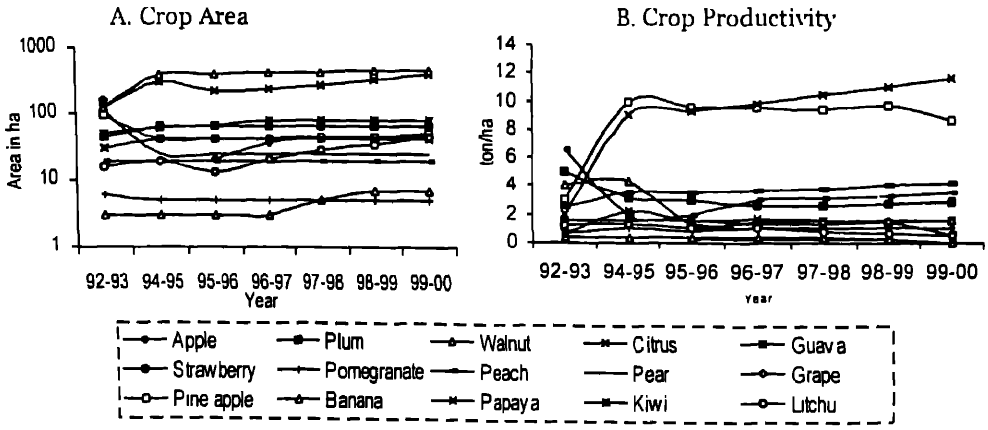
Productivity for plum, guava, pomegranate, peach, papaya followed increasing trend whereas decreasing for trend apple, walnut, citrus, pear, pineapple, banana and litchi was observed.



Dibang Valley

Area expansion for plum, walnut, citrus, guava, banana, litchi followed increasing trend whereas decreasing trend for apple and grape was observed

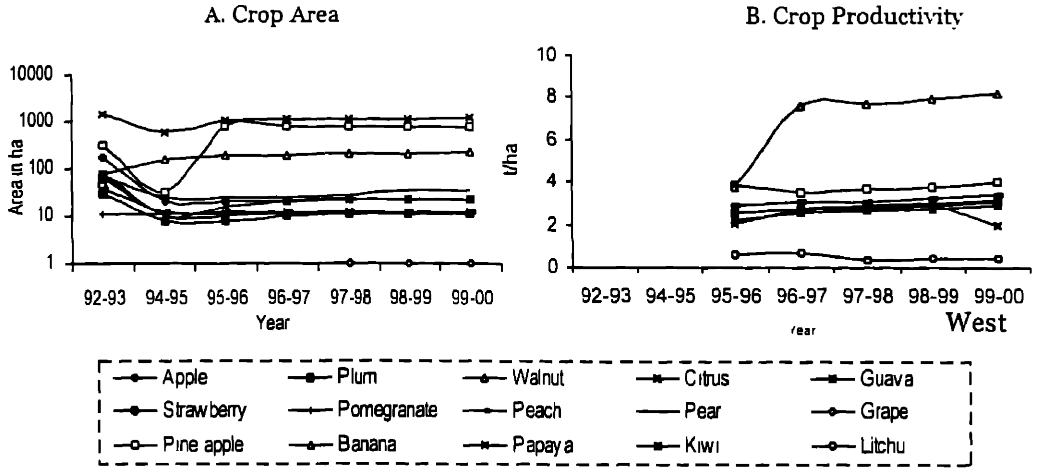
Productivity for pomegranate, peach, pear, pineapple, papaya followed increasing trend whereas decreasing trend for apple, plum, citrus, banana and litchi was observed.



Upper Siang

Area expansions for citrus, guava, pear, pineapple, banana followed increasing trend whereas decreasing trend for plum was observed.

Productivity increasing trend for plum, citrus, guava, pear, banana, papaya and decreasing trend for pineapple and litchi was observed.

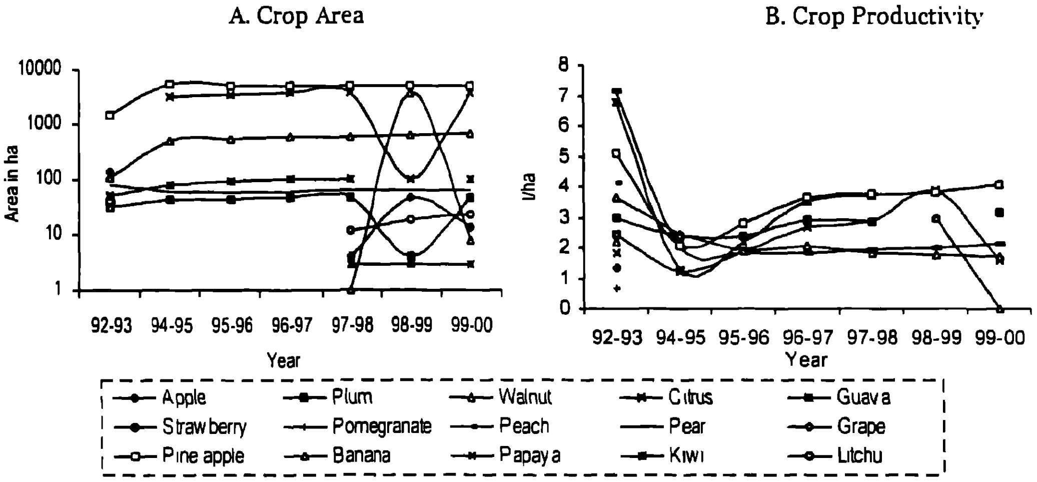

A. Crop Area

B. Crop Productivity

Siang

Area expansion increasing trend for plum, citrus, guava, banana, peach and decreasing trend for apple and walnut was observed.

Productivity increasing trend for apple, plum, walnut, citrus, guava, pear, pineapple and decreasing trend for banana was observed

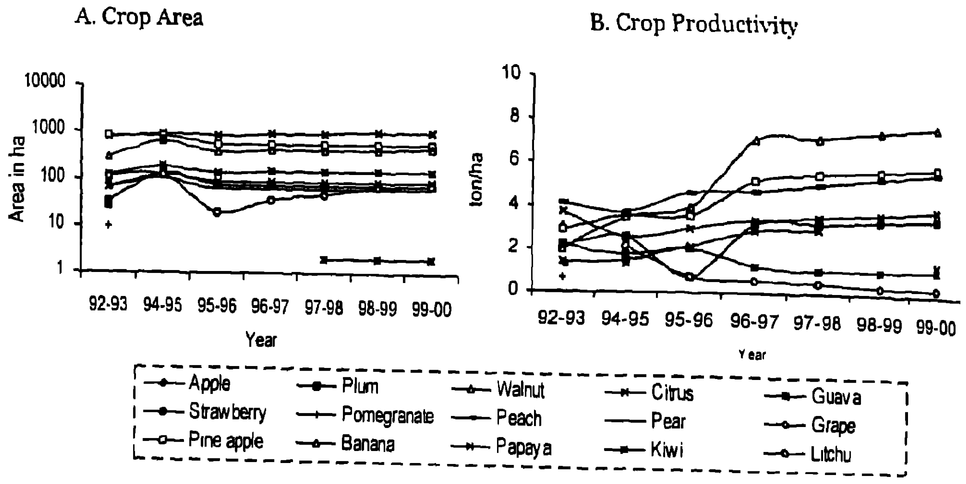

A. Crop Area

B. Crop Productivity

East Siang

Area expansion increasing trend for pineapple, banana, litchi and decreasing trend for citrus and guava have been observed.

Productivity increasing trend for plum, citrus, pear, pineapple, banana, papaya and decreasing trend for guava and litchi have been observed.



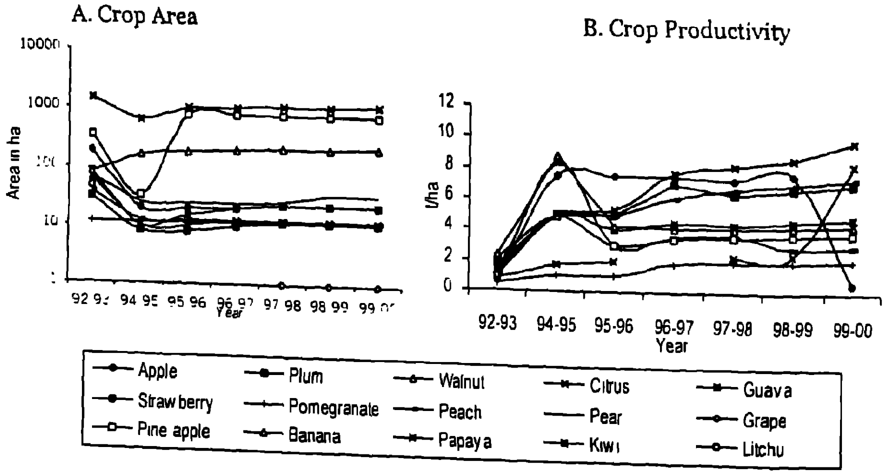
A. Crop Area

B. Crop Productivity

Upper Subansiri

Area expansion increasing trend for plum, citrus, guava, pear, pineapple and banana have been observed.

Productivity increasing trend for apple, plum, citrus, guava, pomegranate, peach, pear, pineapple, banana and papaya have been observed.



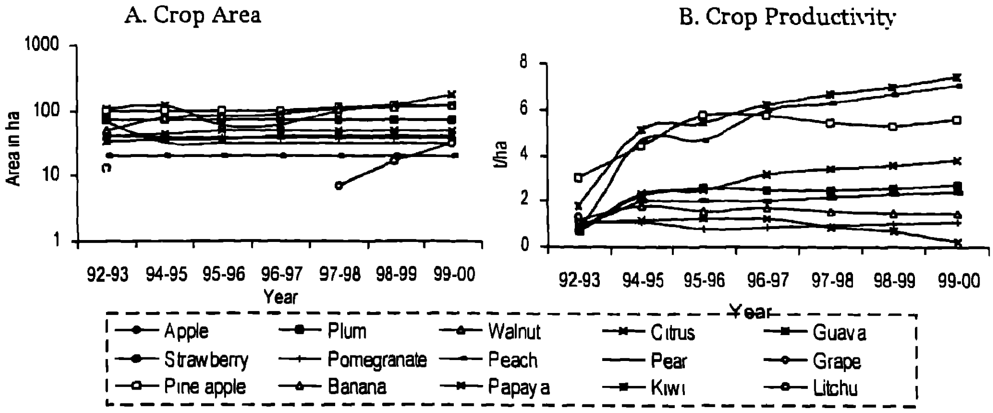
A. Crop Area

B. Crop Productivity

Papumpare

Area expansions increasing trend for citrus, pineapple and banana have been observed.

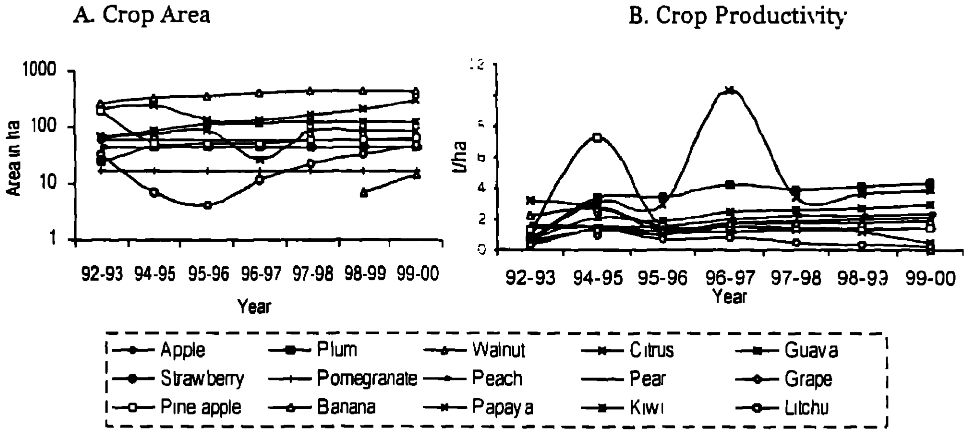
Productivity increasing trend for plum, guava, pomegranate, peach, pear, pineapple, papaya and decreasing trend for citrus and banana have been observed.



Tirap

Area expansion increasing trend for citrus, banana, papaya, litchi and decreasing trend for pineapple have been observed.

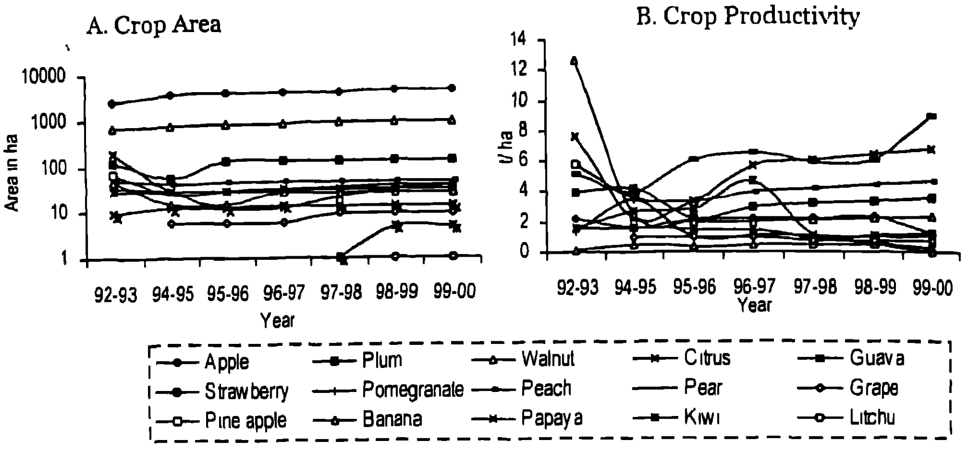
Productivity increasing trend for plum, guava, pomegranate, peach, banana, papaya and decreasing trend for citrus, pear, pineapple and litchi have been observed.



West Kameng

Area expansion increasing trend for apple, plum, walnut, citrus and pear have been observed.

Productivity increasing trend apple, plum, walnut, peach, banana, papaya and decreasing guava and pomegranate have been observed.



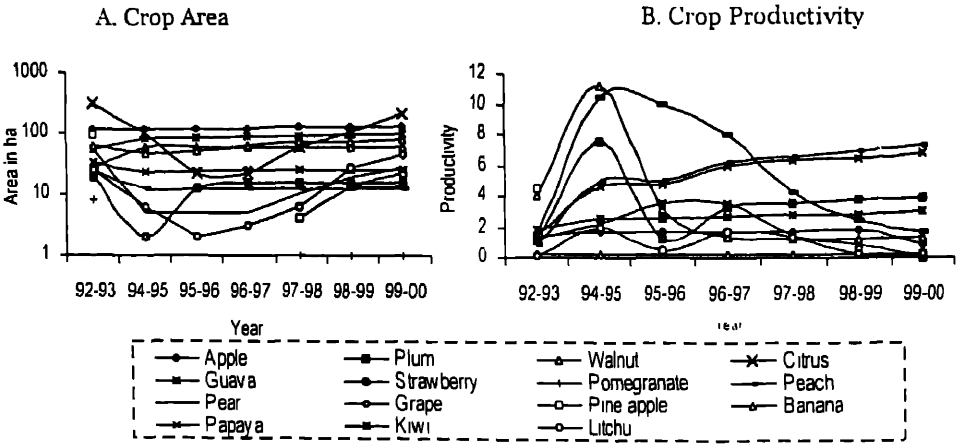
A. Crop Area

B. Crop Productivity

East Kameng

Area expansion increasing trend for apple, citrus, guava, pear, banana and litchi have been observed.

Productivity increasing trend apple, plum, guava, peach, papaya and decreasing trend for citrus, pear, banana and litchi have been observed.

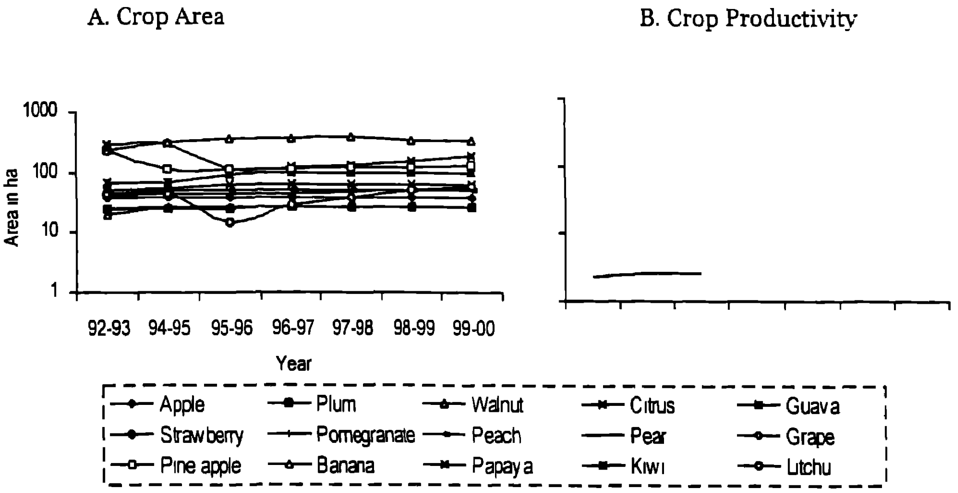


A. Crop Area

B. Crop Productivity

Changlang

Productivity increasing trend for plum, guava, pineapple, banana, papaya and decreasing trend for apple, walnut, citrus, pomegranate, peach, pear and litchi have been observed.


A. Crop Area

B. Crop Productivity

Jhum cultivation status

About 7000 B.C., according to the archaeological evidence (Childe 1956) mankind began to change its mode of life from food gathering to food cultivation, by adopting shifting cultivation, which is, historically, a transitional stage towards more permanent agriculture. Shifting cultivation is also known as jhumming, slash and burn and swidden agriculture, practiced by farming communities living in tropical and subtropical regions. The practice commences with selection of a piece of hill slope, where trees or bushes are cut down partially or fully, left to dry and then burnt in situ. Thereafter crop seeds are dibbled into holes or broadcast, without using ploughs or animal power. The practice is continued for consecutive years (3 to 8 years). Crop yields begin to decline with increasing cropping year. Hill farmers practicing jhumming continue cultivating in the same patch until a decline in the productivity level is reached beyond a sustainable limit. Jhumias (jhum cultivators) moves to a new patch of forest hill slope to repeat the process, and allows the abandoned (fallow) land to recuperate. The system aims at self-sufficiency and does not lead to any capital growth and is a labour intensive form of agriculture demanding human labour and land. The agricultural activity calls for a better fallow management and an integration of improved techniques for increased crop productivity. It has been estimated that regrowth habitat begin attaining biodiversity values closed to those in primary forest only after at least 25 years for birds and 50 to 70 years for woody plants (Tiwari et al 1998). Jhum cultivation in Arunachal Pradesh is one of the primary agricultural activities and most of the indigenous population depends on this farming system for their sustenance. The activity is mostly pronounced within the altitudinal ranges of 500 m to 2000 m msl and thereafter decreasing progressively and not exceeding beyond altitudinal range of 2500 m.

The percentage area distribution of shifting cultivation in Arunachal Pradesh is highest, 15 – 20% in Changlang and Tirap district within an altitudinal range of 500 m to 1500 m, followed by 5-10% in West Kameng, East Kameng and Papum Pare district in an altitudinal range of 900 m to 2000 m, and less than 5% for the remaining districts namely lower Subansiri, Upper Subansiri, West Siang, East Siang, Upper Siang, Dibang Valley and Lohit district in an altitudinal range of 900 m to 2000 m. Jhum cultivation has an intricate relation to land man ratio, the density of population per square km as per 19991 census in Chnglang was 6 to 12, and 20 to 50 persons / km for Tirap district. The population density in West Kameng ranged from 6 to 12 persons / km (in Jhum specific areas), 12 to 20 persons / km East Kameng and 6 to 12 persons / km in (Jhum specific areas) Papum Pare. With ever increasing pressures due to the rise in population and a subsequent increase in demand of community forest for agriculture, has resulted in a decrease in the rotation of the jhuming cycle, causing depletion of forest cover. Consequently, patches of forest are frequently brought under jhumming at an interval of five to six years - a time period that is grossly inadequate for a degraded fallow to recover.

Jhum cycle

A Jhum cycle is composed of two components such as cropping phase and abandoned phase or fallow. The cropping phase (productive phase) is characterized by fertile soils where crops are sown, harvested for livelihood and in the process soil fertility get depleted after some consecutive cropping years. The fallow phase (recovery phase) is maintained for regeneration of vegetation cover or restoration of soil fertility to undergo next cropping phase. The sustainable productivity of jhum depends on efficient management of fallow phase allowing sufficient years to recover. In the beginning jhum was practiced with 2-3 years of cropping phase followed by 20-30 years of fallow phase. Now with the interference of various factors (population pressure, land availability, developmental activities, etc.) the jhum cycle (consecutive cropping year and fallow period) has reduced worldwide. Between 1994 and 1995 the average number of consecutive cropping years in the savanna zone of South Africa has increased from 5 to 8 years. At the same time the average length of fallow period in the forest zone decreased from 14 to 5 years a. Earlier the fallow period of 20-30 years was maintained in the northeast India but with increasing population pressure it has reduced to 3 to 6 years (Borthakur et. al., 1992). In the Arunachal Pradesh context the period under Jhum cultivation varies from place to place and according to the community involved and also depends on the population density and local environmental factors. Areas with increasing population tend to have a reduced fallow period and longer period under cultivation. A district wise Jhum cycle trend with major crops is presented in the table 3.3 for the state.

Table 3.3 . District trends of Jhum cycle in Arunachal Pradesh

Districts.	Period of rotation	Crops grown
Tawang	1 - 5	Maize, millet, wheat & paddy
West Kameng	1 - 5	Paddy, maize, wheat & millet
East Kameng	3 - 11	Paddy, maize & millet
Papumpare	1 - 5	Paddy, maize, millet & potato
Lower Subansiri	1-10	Paddy, maize & millet
Upper Subansiri	2 - 10	Paddy, maize & millet
West Siang	1- 4	Paddy, maize & millet
East Siang	1- 5	Paddy, maize, millet & chilli
Upper Siang	1 - 5	Paddy, maize & millet
Dibang Valley	3 -7	Maize, millet, paddy, arum
Lohit District	2 - 5	Paddy, maize, millet, kodo, wheat, arum, potato & jawar
Changlang	2 - 5	Paddy maize & millet
Tirap	2 - 5	Maize, arum, potato, chilli, paddy, millet, tapioca, wheat

Source. Directorate of Economics and Statistics, 1991.

Crops grown under Jhum

Cropping pattern in Jhum agriculture varies according to the microenvironment and the food habits of the local community. In high rainfall areas paddy is grown as a principal crop with mixed cropping of maize, millet, cotton, etc. as a secondary crop. In the medium rainfall areas, oil seeds and maize are grown as the first crop, followed by millet and rice. In the low rainfall areas, millet are sown along with vegetables with pulses (Thangam, 1979) . In Jhum agriculture, farmers grow cereals,

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[4] west Africa rice research briefNo.2 October 1999. Cover legumes increase productivity of upland rice under intensified land use.

tubers, and leafy vegetable of about 40-45 crop species (Ramakrishnan, 1992) for their livelihood. In Arunachal Pradesh besides rice (both early and late maturing), millets, maize, cotton, pulses, yams, chillies and host of crops that still needs an elaborate identification.

Dependants on Jhum

According to official estimate base on satellite imagery (survey report of FSI), northeastern region has 1, 63 799 sq km of forest, which is 25% of the total forest cover in the country (Anon. 2000)[3]. The age-old practice of shifting cultivation is practiced by 0.45 million jhumias covering 10, 000 sq km of forest cover in the region (Singh 1990). In Arunachal Pradesh a total area of 0.608 million ha is under shifting cultivation area available of which 0.073 million ha area is cultivated in a year involving 0.08 million tribal families (Borthakur, 1992).

Economics

Although the economic and energetic efficiency of jhum is higher than alternative forms of agriculture such as terrace and valley cultivation but with shortening fallow period it suffer a draw back. This is mainly because terrace and valley cultivation needs expensive external input such as fertilisers (which often get leached or lost in the heavy rainfall in hill slopes) and pesticides, besides labour for terracing. Shortened fallow period with increased cropping years have accelerated the erosion of humus rich topsoil resulting in the reduction of productivity with increasing cropping year. The higher monetary output input ratio in Jhumming is reduced with increasing cropping year and shortened fallow period. At times it is no more feasible to practice Jhum cultivation due to increasingly lower monetary output input ratio, thereby forcing Jhum cultivators to shift into new location. A study of 920 sq km in Arunachal Pradesh showed that the value of forest produce burnt annually in the area under shifting cultivation would be about U.S.$600,000 (Thangam, 1979).

Unlike settled agriculture crops grown under jhumming agriculture are mostly local germplasm without inorganic fertilizer. The productivity of the local germplasm under jhum cultivation varies from place to place and is largely influences by micro climate. Workers have estimated farm income from jhumming based on mandays involved in cleaning, sowing, harvesting weeding and other associated activities. Monetary output-input ratios (rupees/ha/year) range from about 1.8 for jhum cycles of 5-10 years to 2.1 for a 20-year jhum cycle. The said ratio is higher than the values for settled terrace cultivation (1.43) and valley cultivation (<1.3). Energetic output-input ratio (MJ/ha/year) in jhum is twice that of valley cultivation and over five times that of terrace cultivation[1]. Even gross returns (rupees/ha) from jhum are about 1.9 times higher than for terrace cultivation[2].

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[3] Forest cover and assessment in North East India issues and policies. P S. Roy & P. K. Joshi. Indian Institute of Remote Sensing (NRSA)

Production and Income from Jhum cultivation

Agricultural income from jhum land in west kameng district is mainly from field crops as the area under horticultural crop is negligible. Paddy, maize, wheat, pulses, millets, Kachu, sweet potato, sesamum, green vegetables tapioca, gourds, pumpkin, cucumber, spices like chillies, ginger are grown in Jhum field. The choice of crop is essentially consumption oriented and a family grows crops to meet its own requirements.

Rapid appraisal on farming patterns and farm economics

A rapid appraisal through village level meeting was carried out in selected areas at of West Kameng district of Arunachal Pradesh to understand the farming pattern and present cropping system for a cost economics estimation. A detail estimation on crop productivity and cost of cultivation from Jhum land would require a detail study on the activities undertaken for Jhum agriculture right from land clearing to harvesting of crops for the first cropping season, followed by the inputs necessary for agricultural activities in the consecutive years.

Crop season

The kharif and rabi are the main crop season in the state. The kharif season starts from March and ends in October. Paddy, millets, maize are the cereal crops predominantly grown during kharif season. Apart from these, various pulses, vegetables, Kachu, tapioca are also raised during kharif season. During rabi season wheat is the only cereal crop grown especially in the settled areas. Mustard, potato, various winter vegetable are the other crops of the season, table 3.4.

Table 3.4 Operations performed in Jhum cultivation

Activity		Time
Selection of land in hill side		September-October
Cutting down of trees and bushes		October-November
Burning of fallen trees and bushes		December-January
Clearing of left over debris		December-January
Sowing/dibbling of seeds		January-March
Intercultural operation (mainly Weeding)		In between cropping period
Harvesting	Millets	May-June
	Maize	June-July
	Kachu	September-October
	Paddy	October-November
	Tapioca	November-December

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[1] P.S. Ramakrishnan, 1992, Shifting Agriculture and Sustainable Development: an interdisciplinary study from north-eastern India MAB Series, Volume 10, UNESCO, Paris

[2] . K.N. Ninan, 1992, 'Economics of shifting cultivation in India', Economic and Political Weekly March 28 A: 2-6.

Source: Primary Survey at West Kameng District, Arunachal Pradesh

Productivity of an area mainly depends on the soil condition and fertility status of the area. Productivity of shifting cultivation directly depends on jhum cycle and fertility status of the soil. Longer the cycle higher is the productivity.

Cropping pattern

Mixed cropping is the usual practice in jhum cultivation. Crop grown and cropping pattern in the shifting cultivation areas are quite different from that of wet paddy cultivation in plain valley areas and terraced area. In jhum areas all the varieties of crops i.e. food and non-food crops are grown in mixture. The major crops grown in the jhum areas are maize, upland paddy, millet, pulses, tuber crops, vegetables etc.

Cropping intensity

It is somewhat complex to work out the cropping intensity in Jhum area because of the mixed cropping nature and lack of record on allocation of area to different crops. Besides some crops are also grown as relay cropping in the Jhum land, which could be taken as area put for cropping more than once. It has been observed that because of the mixed cropping pattern cropping intensity in Jhum land is found to be very low.

Cost and return

The agricultural operations, adoption of technology, crop variety, quantum and type of inputs used determines the cost and return from any type of crop cultivation.

Agricultural operations performed in Jhum cultivation are

- Cutting down of trees and bushes. It is the first operation, which is usually performed in December/January
- Burning of dried trees and bushes: Before onset of pre-monsoon shower during February to march the dried trees and bushes are burnt for clearing.
- Clearing of left over roots and stubbles: The unburned logs, unwanted bushes and roots and stubbles are set aside from the field.
- Dibbling and sowing operations: After the onset of pre monsoon shower dibbling operations with local tools and implements and sowing of seeds are simultaneously performed. A variety of crops are grown in mixture in the jhum field.
- Weeding operations: Usually 3 to 4 weeding are done in one season depending upon the crop grown and intensity of weeds.

- Watching the crops: This is one of the important operations in jhum cultivation. To protect the crop from birds and wild animals watching the field is necessary.
- Harvesting of crops: Harvesting operation require considerably a long time as different crops are matured in different times. Harvesting operation usually starts from July and continue up to December.
- Thrashing and carrying: Thrashing of crops are usually done manually in the field which are later on carried to their home

The input used (Table 3.5) in Jhum cultivation has some differences from other crop cultivation in the hill areas. Human labour is usually from family member, and support from the other farm families of the village undertaking Jhum cultivation, seeds are home produced and no other input from outside sources is used.

Table 3. 5 Cost of Cultivation of all crops in one-hectare Jhum Land

Different operation	Mandays	Cost i (In Rs)
Operational Cost (In Rs)	@ Rs 50/man day	
A. Field preparation		
Jungle cutting and clearing	25	1 250.00
Burning	5	250.00
Clearing (Removing weeds, roots & stubbles)	15	750.00
Dibbling and sowing	15	750.00
Weeding	30	1500.00
Watching of crops	20	1000.00
Harvesting	10	500.00
Threshing and carrying	5	250.00
B. Inputs		
1. Seed	-	500.00
Total Man-days	125	
Total Cost/ha		6750.00

Source: Primary Survey at West Kameng District, Arunachal Pradesh

The assigned productivity of the crops and area percentage for different crops under a single unit {Table 3.6, (chesleo)} are based on discussion with Jhum cultivators and reduction in yield has been based on 20 to 30% under normal production. Cost per kg of produce has been calculated based on market price.

Table 3.6 Cost economics from Jhum cultivation

Crop grown	Productivity (kg/ha)	Cost in Rs /kg	% Area allocation*	Return in Rs Kharif	% Area allocation	Return in Rs Rabi
Paddy	1020	4	60	2448.00	20	816.00
Maize	1039	10	50**	5195.00		
Wheat	1100	5				
Millets	750	5	15	565.00		
Pulses	650	11	25***	1793.00	15	1073.00
Spices	2053	10	5	515.00	5	515.00
Tuber crops	3589	10	10	3590.00	10	3590.00
Sesamum	690	15			10	1035.00

Mustard					5	
Leafy Vegetables	3000	6	5	900.00	15	2700.00
Other crops		NA		NA	20, Potato	5900.00
	10 000				10, radish	5000.00
Total				9811.00/ 1558.00		20629.00

Source: Primary Survey at West Kameng District, Arunachal Pradesh

Sample calculation for 1 chesleo, equivalent to 1 Acre (4000 sq m)

* Area allocation is based on the prevailing cropping pattern (mixed cropping). Hence the total unit area under cultivation exceeds 100%

**Farmer's cultivation maize would not cultivate paddy

*** Area under intercop with miaze

4

Estimation of damage attributed to Jhum cultivation

Impact of Jhum

As Jhum cultivation primarily involves slash and burning of forest vegetation, crop productivity of such agriculture largely depends on the fallow period left for regeneration of the degraded forest. The experts on Jhum agriculture have a common rationale for sustainability of Jhum cultivation with long fallow period (10 years fallow period, Ramakrishnan, 1992). With ever increasing peoples demand and restriction on cutting down of virgin forest, *Jhumias* have reduced the fallow period from 20 years to 3 years and in the extreme cases 1 year fallow period. Reduction in fallow Jhum cycle has a serious impact on economics and environment, where some of the serious impact due to Jhum cultivation is as follows:

Soil fertility decline:

Literature survey reveals that agricultural practice in northeastern region of India experiences reduced crop yield. Such a negative trend is associated with wide gap between plant nutrient removal by crops and nutrient replenishment in the soil. An average replenishment of NPK from organic and mineral sources is below 27 kg/ha whereas depletion/removal by crops of these nutrients is estimated to be more than 120 kg/ha annually[3]. In the Jhum agriculture it is widely experienced that crop yield in the 1st cropping year is very high, followed by a downward trend with the increasing cropping years. Such a downward trend in crop yield is related to decline in soil fertility where soil nutrients mostly NPK are eroded along with soil under heavy rainfall. The nutrient loss is due to burning of dry matter in the shifting cultivation process. About 1.868, 21.5111 and 2.228 million tones of leaves, food and litter containing 137.35, 7.46, 95.95 and 97.50 thousand tones of NPK and calcium respectively are burnt every year. Nutrient loss due to shifting cultivation in north eastern region is estimated to be 6.0 million tones of organic carbon, 9.7 tones of available phosphorus and 5690 tones of potash respectively (Singh et al., 1996). Soil NPK loss due to Jhum cultivation in the northeastern India is 17,092 t/year from 386,900 ha[4]. Arunachal Pradesh alone suffers 3111 t/year NKP loss from 70,000 ha jhum cultivation area. Such a huge NPK loss is very alarming as it results in a significant reduction in the crop yields. Soil analysis studies in shifting cultivation areas in Arunachal Pradesh and Tripura made by Jha *et al.* (1976) indicated that shifting cultivation caused an appreciable change in organic matter content resulting in nutrient imbalances, and reduction in water-holding capacity, sesquioxides, iron, aluminium, nitrogen, calcium, magnesium, potassium, phosphorous, cation exchange capacity and C: N ratio. The pH value decreases, i.e. the soil became more acidic.

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[3] sharma UC and LM Shukla 2001. Fertiliser News. 46(4):115-119.

[4] Mishra A K and U C Sharma Traditional wisdom in range management for resource and environment conservation in north eastern region of India.

Crop productivity:

Crop productivity from jhumming agriculture varies from place to place. Productivity is mostly depends on the quantum of biomass burnt and ash generated that replenishes soil fertility in turn support standing crop. Saha (1976)[5] has reported that crops yield grown under Jhum cultivation in different parts of north eastern region vary from place to place (q/ha): paddy (4-11); maize (0.3-1.7); millets (0.55-4.82); raw cotton (0.05-1.47); sesamum (0.49); turmeric dry (0.31); ginger (0.01-0.12); yam (0.12-0.5); dry chilies (0.04); tobacco (0.07); cassava (0.57-0.60).

Soil erosion:

Farmers' movement in the forest either for selection or cutting down of forest vegetation causes loose soil aggregates; forest litter and earthworm crustings slide down the hill[3]. This activity is followed by slash and burning of the forest for shifting cultivation where soil becomes very loose and exposed to the surface. During rainy season such loose soil without ground cover are dispersed with splash of rainfall and washed away from the higher elevation downwards. Such a severity of soil erosion due to jhumming activities largely depends on the soil type, rainfall intensity, consecutive cropping year, drainage system, slope, type of crops grown etc. Singh and Singh (1978) estimated soil erosion from hill slopes (60-70%) under first year, second year, abandoned jhum (first year fallow) and bamboo forest and found to be 146.6, 170.2, 30.2, and 8.2 tones/ha/year respectively[6]. Annual soil loss in northeastern region is estimated to the tune of 181 million tones due to shifting cultivation (Prasad *et. al*, 1981). Arunachal Pradesh alone contributes 14490 thousand tones soil erosion from 70,000 thousand ha jhumming activities[4]. However opinion differ among the scientists on the proportionate soil loss under jhumming activity and are of the opinion that other natural and artificial influencing factors play a significant role. With reference to shifting cultivation in Arunachal Pradesh, the major cause for large-scale soil erosion and attribute to floods is not a practical opinion in relation to associated internally and peripheral factors.

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[5] ICAR 1983. Shifting cultivation in north east India, ICAR Research Complex for NEH Region, Shillong

[6] Saha N 1976. Levels of production and income under shifting cultivation in NE India. Proc. Of the Seminar on shifting cultivation in N E India. North East Council for Social Sciences Research.

Inferences made through extrapolation superimposing of digitised data on soil type, slope, drainage characteristics, settlement (Villages), Jhum and forest blanks and distribution of rainfall in the state reveals that, soil losses under the different river basins exhibit high trends for four river basins namely Siang, Dibang valley, Lohit and Tirap-Dihing river basins and can be attributed to the high average annual rainfall ranging from 5000 mm to 2000 mm. Soil erosion for Siang, Dibang valley and Lohit river basis is expected to be high in relation to the spatial distribution of rainfall over this basins, the steep slopes ranging from 20 to 25% and above at places.

Siltation and occurrences of floods:

Induced slope failure and mass waiting attributed to Jhuming activity and deforestation of slopes in the periphery of streams and rivers flowing in steep slopes (20 to 25 % and above) at higher altitudes can lead to triggering of minor flash floods. A recent observation has been noticed in the foothill of village Dirme, adjoining Sapper camp. Here land clearing and burning of a small patch of land for agriculture has lead to the slope failure, where the debris and boulders have fallen directly into the stream and have partially obstructed the path of water flow in river Kameng, which eventually can lead to flash floods. However the recent visual observation on jhuming activity and the location of the areas of Jhum have presented different note. Observation of jhuming activity for villages Dirme (2200 m), Dundri (2400 m), Lish Gompache (1850 m), Lish Gompalok (1800 m), Zangdong (2600 m) and Zimthung (2050 m) in Circle Dirang, exhibits Jhum activity far away from the streams and rivers courses, and from gullies and surface runoff areas, vegetation in the gullies and lower reaches towards streams has been excluded and agricultural practise being continued in moulds and flat slopes. The practise can be considered as an example of conservation buffers for sediments and runoff.

Siltation of irrigational channels

Siltation of irrigational channels and canal network is a common phenomena and the factor of siltation is taken into consideration while designing the scheme lay out. Specific designs are incorporated at the intake, canal and at the forebay for desiltation processes. There are various sediment control methods (*location of the intake, offtake draws, tunnel type sediment ejector, turning vanes, vortex tube, settling basins, etc.*) and the mechanism for control would depend on the movement of the sediment in the canal in the form as "bed load" or as "suspended load" in addition to the wash load. One can ignore the fact that sedimentation can possibly lead to damage of irrigation infrastructure, but damage of infrastructure (*roads, bridge, irrigation works, hydropower plants, etc*) is taking place in the state and this can be attributed to the flash floods influenced by mass wasting, a common and widespread phenomenon in the Himalayas.

Damage of road infrastructure and landslides

Damage of road infrastructure and landslides attributes to Jhum is highly intangible. The young age of the Himalayas, coupled with the active orogeny, high seismisity become highly unstable under intense monsoon and slight seismic shocks, results in landslip, rock fall, debri slide, slump depending on the location specific nature of the geological formation and it geological structure. However, one cannot ignore the fact that mass wasting can be aggravated by intense human factor (*inappropriate land use, poor watershed management practice, extension of agriculture in steep slopes, unplanned settlement, poor water management*). The proposed model (rehabilitation package) address the issues by facilitating maximum ground cover strategies through Bioengineering techniques (*hydrological control, infuse soil to the parent rock / base according to the nature and orientation of the beds/formation*), with less importance to physical barriers, which are costly and require frequent maintenance and can be highly unstable in the Himalayas.

Probable impact on rainfall:

The evapotranspiration of ground water from the forest vegetation cools down the atmospheric temperature and encourages higher relative humidity build up. Rainfall of a region is influenced by the quantum of water molecule deposited in the atmosphere as cloud through evapotranspiration from the forest vegetation. The satellite imageries study on forest cover of northeastern region revealed declining trend associated to increasing shifting cultivation and large-scale deforestation (Roy and Joshi, 2002). Depleting forest cover is linked to increasing trend in the atmospheric temperature. Jhum cultivation involves slashing and burning of forest vegetation having some influence on rainfall at the local and regional level. The increasing Jhumming areas in the region may be one of the factors related to reduced rainfall. An estimation of loss/gain in forest cover of Arunachal Pradesh in 1997 reveals 75 sq. km was forest lost due to shifting cultivation of which natural regeneration in the abandoned fallow Jhum land has been 56 sq. km. There was a net loss of 19 sq.km (Basic Statistics of North Eastern Region 2000).

5

Climate and rainfall characteristcs

Characteristics of Precipitation in Arunachal Pradesh

Climate the Indian subcontinent can be considered to have two major seasons and two transitional periods as:

1. South-west monsoon, (June – September)
2. Transition – I, Post-monsoon, (October – November)
3. Winter rainfall, (December – February)
4. Transition – II, Summer, (March – May)

Spatial and Temporal Variation in Precipitation

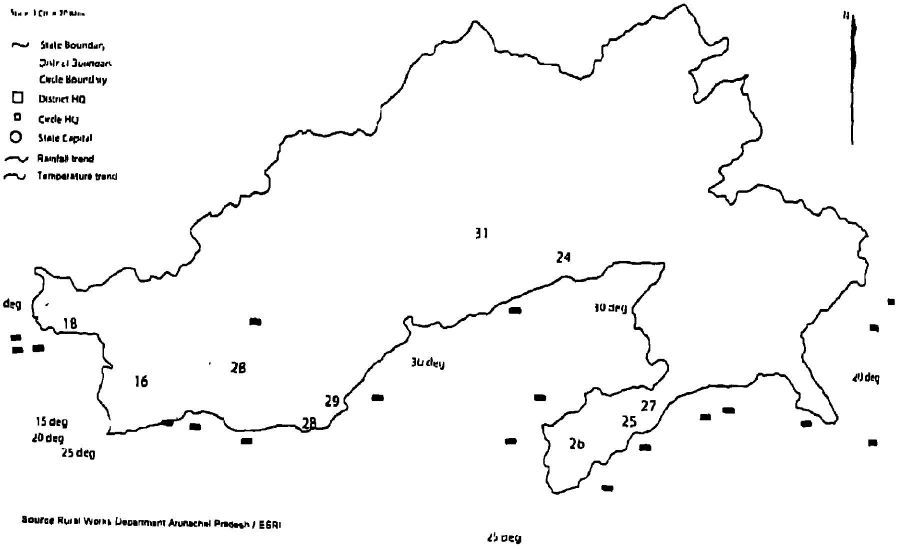
The average annual precipitation in Arunachal Pradesh is about 2949.22 mm. Where, max precipitation (200 to 400 mm) is received within an altitude of 500 to 3500 m during the SW monsoon. About 27.26 % is received during March to May (Summer Rainfall), 60.88 % is received during the month of June to September under the influenced of south - west monsoon and 6.53 % during October and November under the post monsoon period and finally 5.32 % under Winter rainfall commencing from December and ending in February.

South-West Monsoon (June - September)

The South – West monsoon (popularly known as monsoon) is the principal rainy season when 75 % of the annual rainfall is received over a major portion of the country. The south- west monsoon is the principal sources of rain with July as the rainiest month. The monsoon originates in the Indian Ocean by the end of May and the onset of monsoon is accompanied by high southwesterly winds at speeds of 30 – 70 kmph and with low-pressure regions at the advancing edge. The monsoon winds advance across the country into two branches, where the Bay of Bengal branch enters Assam valley by last week of June. The monsoon winds increase from June to July and begin to weaken in September.

Precipitation characterises in the state is characterised by high (600 cm) rainfall in the region adjoining Pasighat, Roing, Tezu, Namsai, Khonsa, Dibrugar, Tinsukis which is the major confluence point for rivers (-------) flowing from Arunachal Pradesh. The high moisture generated form the said zone generates additional moisture in the air leading to high precipitation. The abrupt rise of the Himalayan mountain chain in Arunachal Pradesh complicates the climate of the region influenced by topographic variations leading to the meso and microclimate. Hence with the increase in the elevation the spatial distribution of the rainfall decreases (100 cm) in the higher Himalayas.

SOUTH WEST MONSOON RAINFALL & TEMPERATURE

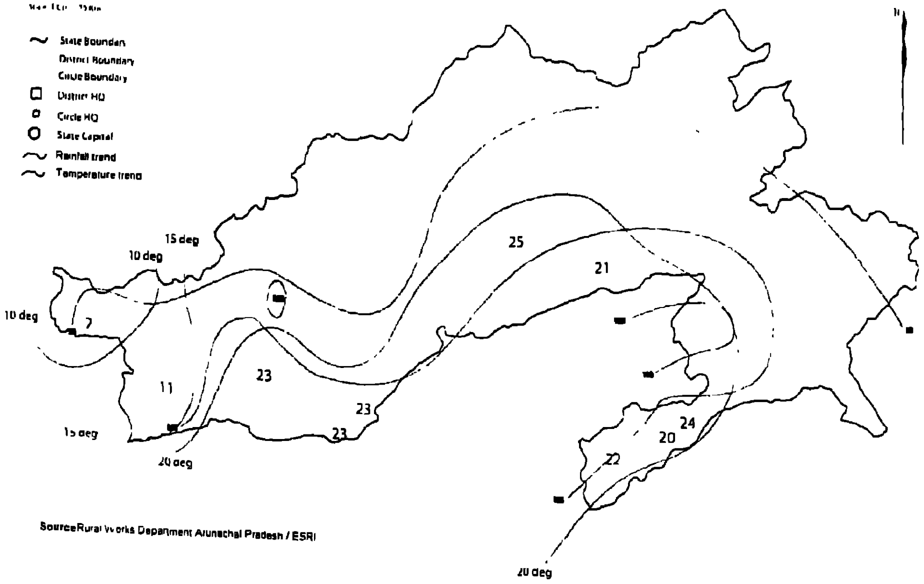


Source Rural Works Department Arunachal Pradesh / ESRI

Post - Monsoon (October - November)

With the retreat of the south-west monsoon, low-pressure areas form in the bay of Bengal and a north-easterly flow of air is formed which picks up moisture in the bay of Bengal and moves towards the region, where additional moisture is supplemented where by an average rainfall raining from 100 of 150 cm is observed in Namsai, Bordumsa, Diyun and in the Tinsukia. It is presumed that the rainfall is influend by the confluence point of the river Brahamaputra with its tributaries.

POST MONSOON RAINFALL & TEMPERATURE



Source Rural Works Department Arunachal Pradesh / ESRI

Temperature trends

Write up comparing National, World and Arunachal Pradesh under preparation

Climate change:

The forest vegetation plays key role in maintaining equilibrium of the regional micro or macroclimate. Since the last couple of decades, earth experiences an increase in ambient atmospheric temperature mostly due to anthropogenic interferences. One of the main causes for global warming is increase of CO2 level in atmosphere that traps the reflected heat from earth surface causing green house effect. The earth's climate is under a process of change, induced by the resultant human activities altering chemical composition of the atmosphere through the build up of the green house gases- primarily carbon dioxide, methane, nitrous oxide and chlorofluorocarbons with enormous heat trapping capacities. Records suggest that the world has already warmed by 0.3 to 0.60 since 1860 and during the last two decades have been the warmest. The IPCC (Intergovernmental Panel on Climate Change) in its third assessment report for the last 5 years of the climate change research project an increase in the global temperature from 1.40 C to 5.8 C over the period from 1999 to 2100. Such a rapid rate of change in the environment will leave little room for the ecosystem to adapt itself to the change making it vulnerable. Species (plants) will be more vulnerable because of climate change as they would have to deal with a variety of new competitors, predators, diseases and alien species for which they will have no defence. Existing forest areas will tend to migrate towards higer altitudes and finally lead to possible extinction. The highly effected and vulnerable groups would be the farming communities located in the plains and in the mountains.

Since the forest vegetation is ever increasingly depleted due to jhumming and other developmental activities in one hand and CO2 emitting from various sources (agricultural activity, mining, fossil fuel burning, industrial activities, etc.) in the atmosphere on the other, resulted disturbance in the balance of source and sink of CO2. Since Jhumming agriculture involves cutting down and burning of forest vegetation thereby contributing towards CO2 emittence and climate change.

Winter Rainfall (December - February)

By mid-December, disturbances of extra tropical origin travel eastwards across Afghanistan and Pakistan, known as western disturbances and cause moderate to heavy rain and snowfall in the Himalayas. The rainfall outline in the Eastern Himalayas of Arunachal Pradesh ranges from 50 cm & above in the lower altitudes and with progressive rise in the elevation the precipitation decreases to less than 50 cm. However pockets of local variation is noticed in Anani, Hayuliang and Chayantajo.

Summer Rainfall (March - May)

CP problem with printing

Annual rainfall

CP problem with printing

6 Natural hazards in Arunachal Pradesh

Mountain slopes in the Himalayas are conditionally stable and therefore there is a general tendency for mountain slopes to slide down, making them inherently hazardous. Natural hazards resulting in erosion, deforestation, decline of flow in streams, effect on flood hydrology and soil loss are controlled by various parameters, which can be natural (*geology, topography, hydrology, vegetative cover and climate*) and artificial (*inappropriate land use, deforestation, extensive agriculture in steep slopes, poor water management, etc*) and would vary from river basin to river basin through out the state.

Orogenesis

Most of the mountain ranges in the middle Himalayas of Arunachal Pradesh are under a stage of active orogenesis, attributed to the collision of two continental plates, the Asian and the Indian mass forming a collision type of orogenic belt - a linear region that has undergone folding, faulting and other deformation under an orogenic (geotectonic) cycle. The mountain range accompanies a major global seismic belt where earthquakes in the magnitude of 4.5 to 5.5 occur every year.

The Himalaya is tectonically active and hence is vulnerable to natural and artificial hazards. The recent inference on its active orogeny was reported by the local community from Rama Camp, West Kameng district for a particular mountain locally called Shermelong, one of the ranges within the sela pass (3500 m to 4000m). Shermelong is being reported to gain its elevation by about an 1" in each year. The particular observation is one of the cases reported and ground survey for areas within this altitudinal range would bring light to additional reporting for such events.

Influences of slope[1]

Slope is a determining indicator for relief energy because it helps in erosional and depositional features relating to intensity and mass movement and landslide. Very steep and steep slope gradient (above 25%) has been recorded Kameng Himalaya, the reach of Upper Subansiri basin, the upper most part of Siang valley. High to extremely strong gradients of slope (15-25%) are marked along with Northern as well as Southern sides of steep slope zone of the borderlands. The fairly strong and strong slopes (8-15%) are generally recorded in the foot hill areas of Siwaliks, especially the western Arunachal himalaya and the eastern Arunachal himalaya including the Patkai, Mismi hills of Lohit and Changlang district and Tirap , Changlang district and the border hill district of Dibang valley. Moderate slope gradient (4-8%) are marked only in a longitudinal belt of lower foot hill zones of the Siwaliks including the lower parts of Eastern Arunachal Himalaya. Depositional areas in the lower reaches of lower Subansiri, Siang, Dibang valley and Lohit rivers, comes under the categories of low and gentle slopes (below 4%).

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[1] A Resource Atlas of Arunachal Pradesh. NEHU. S Singh, 1999

Spatial distribution of earthquake epicentres

In Arunachal Pradesh (Eastern Himalayas) the magnitude of earthquake ranges from 5 to 8 and above in the Richter scale. A seismic magnitude of 5 on the Richter scale can be taken as the lower limit for potential damage to infrastructure. The potential range of seismisity has been depicted in circles, where the size of the circle depicts the range of intensity for the epicentres. It may be seen that the major areas in the higher reaches of Arunachal Pradesh exhibits pockets of variable (5-8) seismicity, where as the north-eastern corner of Arunachal Pradesh exhibits the maximum concentration. Zemithang and Dudunghar circle of Tawang district exhibits the epicentres of 6 to < 6.5 and 5 to <6. Dirang , Nafra and Rupa(Tenga valley) circle of West kameng district exhibits the epicentres of 7 to < 7.5 and 5 to <6. Sarli circle of Kurung Kamey district exhibits the epicentre of 8 and above. Giba, Taliha and Payeng circle of Upper Subansiri district exhibits the epicentres of 6 to < 6.5 and 5 to <6. West Siang district through out exhibits a linear distribution of earthquake epicentres ranging from 6 to < 7 , 6 to <6.5 and 5 top <6 at richter scale. Tutting and Singa circles of Upper Siang district exhibit epicentre of 7 to < 7.5, Gelling and its adjoining area in Tibet exhibit epicentre of 6 to < 7 and 6 to < 6.5. Mipi, Anini , Italin and Roing circles of Dibang Valley district exhibit epicentres of 7 to < 7.5, 6 to < 7, 6 to < 6.5 and 5 to <6. Chaglagam exhibits epicentre of 8 and above, Hayliang, Manchal and Hawai exhibits epicentre of 6 to <6.5. Vijaynagar circle of Changlang district and its upper reaches in Myanmar exhibits epicentres of 7 to < 7.5, 6 to < 7, 6 to < 6.5 and 5 to <6. Panchoo and Ramjao circles of Tirap district exhibits the epicentres of 7 to < 7.5 and 6 to < 6.5

Natural hazards in different elevation zones

Glaciers are river of ice and are dynamic systems, sensitive to surrounding and change their shape and form and are largely influenced by the local environment. Glacier movement occurs due to the internal flow of ice and its slippage over bedrock, moving a few centimetres per day. Glacial advance and retreat is controlled by pressure, temperature and other micrometeorological elements e.g. radiation, Himalayan glaciers produce a large volume of rock debris and have large lateral and terminal moraines. As a result moraine –dammed lakes commonly form in front of retreating glaciers. These are unstable and a slight disturbance by seismisity or heavy rainfall can easily result in an abrupt release of stored water and rock debris (Yamada, 1993).

Glaciers in the Indian Himalayas cover an area 38,039 km^2, where Arunachal Pradesh has 162 glaciers covering 228 km^2 with an average size of 1.41 km^2 . Studies related to hydrochemistry of meltwater, sediment transfer and glacial hydrology were conducted by Hasnain (1996), Hasnain and Thayyen (1999a,b) highlights the occurrence of high sulphate content during the seasonal high discharges and glacially controlled sediment exhaust is off set between July and mid September by the impact of monsoonal regime on the supraglacial covered glaciers. Studies on glaciers and the occurrences of glacial lake outburst (GLOP) influenced by deforestation, natural land slides, land degradation and increasing population for Nepal and Bhutan Himalaya has been assessed under UNEP initiative. But such vital information for Eastern Himalayas (Arunachal Pradesh) is yet to be generated.

The study for Nepal and Bhutan Himalayas has identified 44 newly formed glacial lakes 24 in Nepal and 20 in Bhutan, which adjoins Arunachal Pradesh that could collapse within the next five years. Glaciers melting faster than normal under a temperature rise of one degree Celsius since the seventies have formed the lakes. Many of the potentially disastrous lakes have formed in Kashmir, along the China border and in the border areas of Arunachal Pradesh, (UNEP, *April 2002* report).

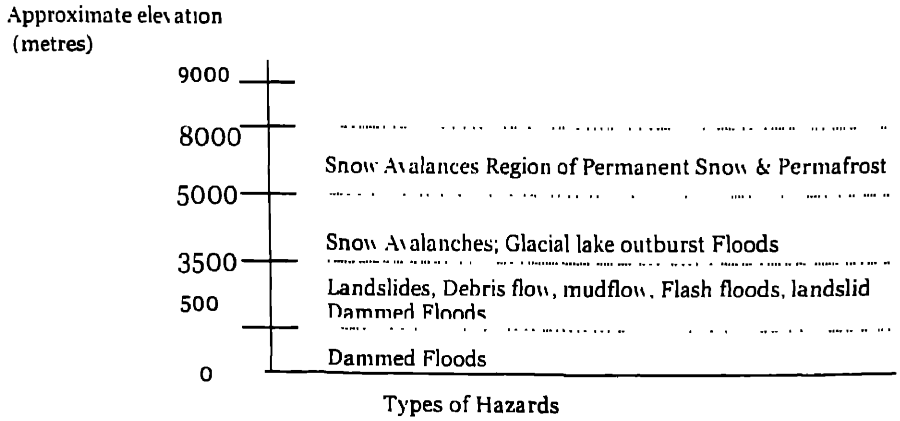
Slope failure and mass wasting

A common cause for soil erosion has been slope failure and mass wasting, and is a very widespread phenomenon faced throughout the Himalaya. It is a process through which large masses of earth material move downhill under gravity, in a slow creeping mode or as rapid landslides. Slope failure along river and streams is a common observation in the rivers of Arunachal Pradesh and is strongly controlled by bedrock geology, its orientation and its structural parameters and triggered by climatic and seismic events. Mass wasting is another frequent and widely dispersed manifestation of the fragility of the Himalayan terrain and is basically a natural process, and with intense human activities the process of mass wasting is aggravated together with its impact and scale. Major mass wasting process is active especially in narrow ravines; often result in the formation of a debris dam. Depending on the size of the obstruction, lakes are formed behind the dams, which subsequently burst open under hydrostatic pressure. This is an essential geomorphological feature of the Himalaya and the resulting flash flood may cause catastrophe downstream, increase silt load drastically, bury agricultural fields or settlements and such relative humidity, evaporation & wind direction. Glacial erosion takes place due to abrasion and movement of rock fragments in glacier mass. Erosion and undercutting of steep slopes takes place by glacier sapping and glacier milling takes place by circulation of melt water in the glacier crevasses and depressions and has the capacity to transport rock debris. Generally sediments move slowly with speed of 1m/d in ice mass but transport over glacier margin, debris flow, running water & wind operate at much faster speed. Glacier lake outburst floods occur due to breaking of moraine or glacier dammed lakes.

Potential areas of Snow Avalanches; Glacial lake outburst Floods in Arunachal Pradesh has been observed through out the higher altitudes from 3500 m and beyond along the northern border of the state adjoining Tibet, excluding the Arakan Yoma belt (Tirap and Changlang Districts). The potential area has been demarcated on the state map through contours.

Climate change in the Himalayas is essentially dominated by he south-west monsoon providing most of the precipitation in the Eastern Himalayas (Arunachal Pradesh) during the summer months. This acts as a trigger for various types of natural hazards in different elevation zones, where maximum precipitation is received within the altitude of 500 to 3500 m. Snow avalanches and glacial lake outburst floods predominate at high elevations (above 3500m). Landslides, debris flow, mud flow, flash floods and landslides in the altitudes ranging from 500 to 3500 m and floods below 500 m which comprise the lower valleys and plains.

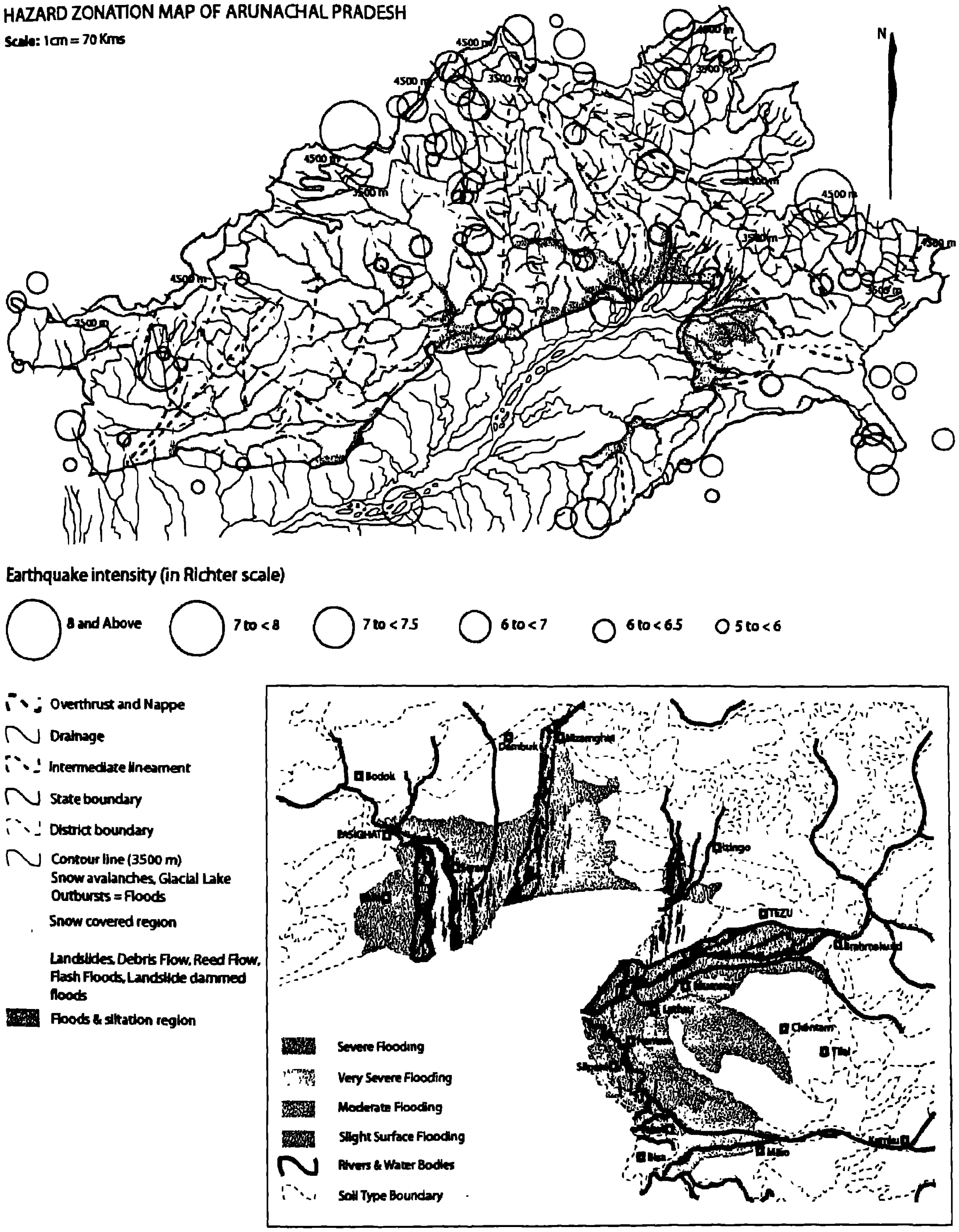
Types of natural hazards in different elevation Zones of the HKH


Approximate elevation (metres)
9000
8000
5000
3500
500
0
Snow Avalances Region of Permanent Snow & Permafrost
Snow Avalanches; Glacial lake outburst Floods
Landslides, Debris flow, mudflow, Flash floods, landslid Dammed Floods
Dammed Floods
Types of Hazards

Source. Landslide Hazard Mitigation in the Hindu Kush- Himalayas, ICIMOD

The relatively young age of the Himalayan mountain with their large and active glaciers, high seismisity, steep valley with frequent avalanching and intense monsoonal rainfall, support high erosion rates (Hasnain and Chauhan 1993).

experiences have been reported recently during 2002 in Sapper Camp and 9th mile in West Kameng district of Arunachal Pradesh.



HAZARD ZONATION MAP OF ARUNACHAL PRADESH

7

Identification of crops as alternate to Jhum

Identification of alternative crops

Archeological findings reveal shifting cultivation is the pioneer from of agriculture in the course of transitional phases of civilization and has remained closely associated with the socio cultural activities of the indigenous people. In the course of time *Jhum cultivators* have gathered indigenous knowledge (techniques) for management of Jhum agriculture to the extent sustainable, and has been followed generation after generation. Hitherto, published scientific literature on sustainability of shifting cultivation directed towards the length of crop cycle. With the ever-increasing population and limited forestland available for shifting cultivation. the crop cycle has reduced from 20 years to 3 years resulting in a serious threat to environment. To overcome such a vulnerable situation, change in farming system from shifting agriculture to settle agriculture is need of the hour. Therefore to encourage settled cultivation, priority must be given those crop grown in age old shifting cultivation system to meet up their livelihood requirements and simultaneously identify alternate crops mainly legumes, horticulture crops, medicinal plants for cash generation. However, selection of alternative crops would be undertaken in consultation with Jhum cultivators and planners. Following are list crops ecologically suitable in Arunachal Pradesh as alternative crops to supplement high land agriculture.

Agricultural crops

Cereals

Rice, Maize. Wheat, Millet, Barley, Buckwheat,

Pulses

Legumes (pigeon pea, rice beans, green gram, winged beans, broad beans, Dolichos, and sword beans includes *Shuteria spontaneum, S. longisetosus, S. procerum,* and *S. sikkimenses,* Soyabean, Rajmash)

Vegetables

Potato, Sweet potato, Brinjal, Tapioca, Arrawroot, Alocacia, Colocasia, leafy vegetable, roots, stem etc In Arunachal Pradesh nearly 300 species of plants are foraged--including 50 kinds of leafy vegetables, 25 types of tubers and rhizomes, 10 kinds of flowering plants, and 15 types of seeds and grains (Haridasan *et al* 1990).

Oilseeds

Mustard, Rapeseed, Sesamum, Ground nut, Sunflower, Pinshing, *Perila fruitescence, Mentha, Litsea citrata,* Bulgarian rose, Palmarose

Horticultural crops[1]

Trees

Citrus, Apple, Walnut, Guava, Pear, Plum, Litchi, Papaya, Jackfruit, Peach, Mango, Coconut, Arecanut, Orange.

Climbers

Black pepper, Grapes, Kiwi, Passion fruit.

Herbs

Pineapple, Ginger, Cardamom, Turmeric, Chilies, Banana,

Medicinal plants

Arunachal Pradesh is exceptionally rich in medicinal plants, especially in its easternmost extension Extensive knowledge of the environment is a necessary part of this adaptation as foraging depends on peoples ability to anticipate and find the always changing distribution of edible species

Herbs

Andrographis paniculata, Coptis teeta, Withenia somnifera, Swertia chirata Nardostachys jatamansi, Bacopa monieri, Panax sikkimensis, Panax sp. Picrorrhiza kurroa, Gymnadaenia archidis, Aconitum ferox, A. heterophyllum, Glycyrrhiza glabra,

Shrubs

Rauwalfia serpentina, R. tetraphylla, Embelia ribes, Berberis aristata.

Trees

Garcinia indica, Oroxylum indicum, Illicium grifithii, Taxus baccata, Emblica officinalis, Saraca asoca.

Climber

Gymnema sylvestre, Dioscorea floribunda, Tinaspora cordifolia, Rubia cordifolia, Piper longum, P. brachystachyum, P. mullesua, P. peepuloids, Asparagus racemosus

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[1] According to area wise ranking Arunchalpradesh.nic.com

Forestry species

Albizia arunachalensis, Alnus nepalensis, Aquilaria agallocha

Bamboo

Dendrocalamus hamiltonii,Bambusa pallida,Pseudostachyum polymorphum

Miscellaneous

Livistona, Calamus erectus

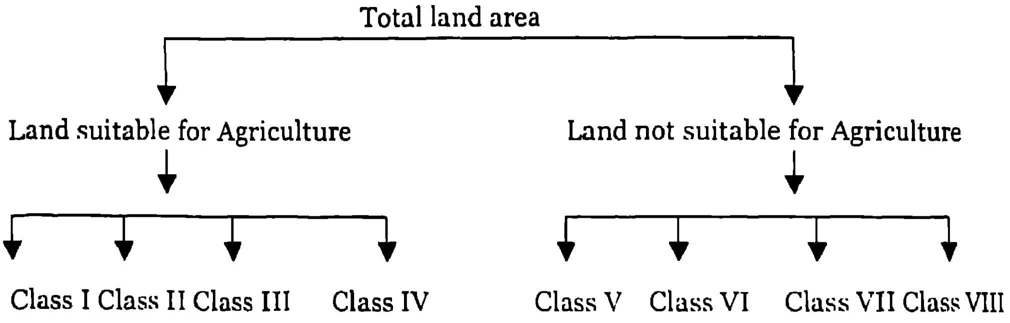
Designing an agro climate specific model rehabilitation package

Development and implementation of rehabilitation package for Jhum cultivators is a challenging task. For a successful package, it is essential to maintain the variety of crops that are generally grown in Jhum fields since generations. Addressing the livelihood requirement of the Jhum cultivators through an efficient indigenous farm management practice would help in developing a close rapport with the Jhum cultivators. Once the livelihood requirement is addressed in the package with the preference of the Jhum cultivators, an effective implementable package would be developed. Improvement in the living standard of the Jhum cultivators would be brought about through supplementary cash by cultivation of horticultural, medicinal and timber crops through technological interventions. As Arunachal Pradesh shares major part of Eastern Himalayas harboring rich flora and fauna, recognized as one of the 25-biodiversity hots spots of the world, the selection of species then becomes essential to encourage rich biodiversity in the rehabilitation package. The polyculture of various crops with timber and others component is necessary to maintain the biodiversity, agroecosystem process, soil nutrient management and checking erosion to the extent possible. Impact of Jhum agriculture could be reduced to minimum if the Jhum land is selected in compatible with drainage system, parent rock fromation, soil type, size of catchment area, agroclimate, etc.

After a critical analysis of the physiography of the state, a detail agroclimate zonation covering four specific agroclimate namely, tropical, subtropical, temperate and alpine has been identified (Map, Agro climate Zonation of Arunachal Pradesh) . With reference to the developed model, potential areas specific to each of the Zonation are further identified with respect to geology, soil type, rainfall, temperature, vegetation type, existing horticulture and agriculture farming system, water availability with respect to the selected crops. In addition to the technical zonation, implementable potential, acceptability by the community and suitability of the government programmes (*analysis of the ongoing and completed*) would be assessed through community interaction.

Determining the Land Capability Class

Land capability assessment is an interpretation inferred from evaluating a group of resource information. It provides a ranking of the ability of an area to support a range of agricultural activities on a sustainable basis. Land capability determination is classified into two groups i.e. I) land fit for agriculture and II) land not fit for agriculture. Again each group is further classified into four land capability classes as per its suitability and hazards that limit the use of the land. The said classification is represented below:



For ascertaining the land capability class of a designated area of land it is necessary to acquire the primary field information those relating to the soil characters and the topographic land features. The soil characters are texture (T), depth (d), Permeability (D), of the soil. The associated land features are slope (s) and erosion condition of the land surface (e)

The land capability class is determined by the most severe limitation. Capability rating is an overall assessment to which the land can be marked to a class by judging the inherent soil properties and associated land feature that are determined in the field, where individual property are assessed on its own merit.

The overall rating of any land (Mapping Unit) can be assigned to its capability class based on the following formula

$$\frac{T \qquad d}{S \qquad E}$$

The overall rating of any land unit would be assigned the worst hazard category and therefore the land use would be the ideal factor for determining the land capability. The table 7.1 on land capability, can lead to an understanding to assigning land capability.

Table 7.1 Understanding Soil and Land capability

Land Capability	Erosion	Soil depth	Soil texture	Slope class
I	Up to 25% of top soil loss. No apparent or slight erosion	Above 36", very deep soil	Sandy loam, loam, Silty loam, Silt, Sandy clay loam, Clay loam, Silty clay loam	0-1%
II	Up to 25% of top soil loss. No apparent or sligh erosion	18" to 35", Deep soil	Snady clay, Silty clay	1 -3 % & 5 - 10 %
III	25% - 75%, ¼ - ¾ top soil loss, moderate erosion	9" to 18" Moderately deep soil	Loamy Sand, Clay	3 -5 %
IV	75% - 100%, top lost & 25% of top sub soil loss, severe erosion	3" to 9" Shallow soil	Sand	10 -15 %
V	Presence of frequent gullies or sand dulves, very severe erosion	3" to 9" Shallow soil		15 -25 %
VI	Presence of frequent gullies or sand dulves, very severe erosion	3" or less, very shallow soil		25 -35 %
VII	Presence of frequent gullies or sand dulves, very severe erosion	3" or less, very shallow soil		35 -50 %
VIII		3" or less, very shallow soil		More than 50%

Source: Soil and Land capability study, AGARAGAMEE

Tropical (elevation >900m msl)

Soil types

Soil of warm per-humid, Eastern Himalayas

The soils of warm per-humid, Eastern Himalayas are mostly shallow, deep, and loamy-skeletal to sandy skeletal, excessively drained. The soil lacks profile development (A/C horizons). The texture varies from gravely loam to gravel sandy loam and classified as Lithic and Typic Udorthents, Entic Haplumbrepts, Dystric Eutrochrepts, Umbric and or Typic Dystrochrepts The soil on moderate to steep hill slops are swallow to deep, clays skeletal, fine-loam to fine. The soils have some the degree of profile development and have structural / colour B-horizon. The soil are classified as Umbric / Typic Dystrochrepts

Soils on moderate hill Slop are deep, well drained, fine/ fine-loamy / clayey/ loamy skeletal in particle size classes and moderately eroded with well developed B horizon, classified as Typic Kandihumults, Umbric/ Typic Dystrochrepts, Pachic Haplumbrets.

These soils have only moderately acidic in nature (pH 4.5 to 7.2), rich in organic matter content (0.8 to 5.2% OC) which declines sharply with depth. The CEC of the soils is low to medium (3.5 to 23.3 cmol (p+) kg $^{-1}$) and generally the base saturation is very low to medium. Appreciable amount of exchangeable Al^{3+} is observed in the soils ranging from trace to 9.7 cmol (p+) kg^{-1} which increased depth.

Soil of warm per humid, Siwalik Hill Ecosystem

The soils at the summits and the ridges are excessively drained, loamy-skeletal or fine –loamy in particle size classes , with little profile development / colour B horizons. The soils classified as Typic/ Umbric, Dystrochrepts, Dystric Eutrochrepts and Typic Udorthensts. Soils on hill slops are deep, excessively drained loam, skeletal, fine loamy / coarse loamy in texture. The soils exhibits profile development of A/C horizons.

The soils are strongly to moderately acidic (pH 4.2 to 5.7) and organic matter content of surface soils is medium to high (1.0-2.5 5 OC). The CEC of soils is low to medium (3.6 to 12.5 cmol (p+)kg^{-1}) with low to medium base saturation and the exchangeable Al content varies from trace to 4.3 cmol (p+) $^{-1}$ which increased depth

Soils of hot humid, plain Ecosystem.

Soils in upper piedmonts areas are moderately shallow to deep, well drained, loamy-skeletal or coarse loamy in texture, classified as Typic Udorthents, umbric Dystrochrepts, Entic/Cumulic Haplumbrets and Dystric Eutrochrepts. Soils on undulating upland and gently sloping plain are deep, well to imperfectly drained, fine /fine-loamy/ coarse-loamy or coarse-silty in texture. Soils of upland show A-B-C profile development whereas some soils in gently slopping plain show the begging of profile development, classified as Fluventic/umbric, Typic Dystrochrepts, Aeric /Typic haplaquepts, Typic Kandihumults and Typic Fluvaquents. The Soils developed in recent and active flood plains are deep, well to moderately well drained, coarse-loamy to coarse-silty in texture with moderate flooding hazards. the soils are classified as Mollic/ Typic Udifluvents, Fluventic/ Typic Dystrochrepts, Aquic Udipsamments, Aeric / Typic Fluvaquents. Soils on channel bars are moderately shallow, somewhat excessively drained, sandy in texture and are classified as Typic Udipsamments. Soils on upper piedmont, upland and gently sloping plain are moderately to slightly acidic in nature (pH 4.6 to 5.8) and moderate to high organic matter content (1.3 to 3.7 % OC). The CEC of the soils ranges 3.7 to 15.2 cmol (p+) kg^{-1} and they are moderate to poor in base saturation. On the contrary, the soils on flood plains area are slightly acidic to mildly alkaline in reaction (pH 5.5 to 8.4) and have moderate to high base saturation.

Soil of warm per humid, North-Eastern Hills (Purvanchal) Ecosystem

The climate of the region is characterised by warm summers and cold winters. The mean annual precipitation varies from 1960 to 3450 mm, which exceeds the potential evapotranspiration (PET) in most years. The region experiences a short water deficit due to seasonal dry spells in the post monsoon period. The represents 'Udic' soil moisture regime. The soil temperature regime varies from "Hyperthermic" in valleys and low hill ranges and 'Thermic' in high hill ranges.

Soil developed on moderately sloping low altitudinal hill range with interminent narrow valleys are deep, well to imperfectly drained, fine-loamy and clayey-skeletal particle size classes with moderate erosion hazard. They are classified as Fluventic Haplumbrepts, Typic Dystrochrepts, Typic Haplohumults, Typic Palehumults, Aeric Haplaquents and Aeric Haplauepts.

The soils developed on moderately steep-to-steep slopes of low altitudinal hill ranges are moderately deep-to-deep, well to somewhat excessively drained, loamy-skeletal, fine loamy/ fine in texture and moderate to severely eroded. Most soils have coloured and / or structural B-horizons and at places argillic horizon which exhibit distinct profile development. Soils are classified as Umbric/Typic Dystrochrepts, Typic/Pachic haplumbrepts, Typic kandihumults and Typic Udorthents.

Soils developed on side slopes of high altitudinal hills are shallow to deep, well to excessively drained, loamy-skeletal/ clayey-skeletal/fine in texture with moderate to severe erosion hazards. Soils are classified as Lithic/ Typic Udorthents, Umbric / Typic Dystrochrepts, Typic / Pachic haplumbrepts, Typic kanhaplohumults.

Soils are strongly to moderately acidic in reaction (pH 4.3 – 5.6) and rich in organic matter (1.0 to 3.4 % OC). The clay contents of the subsoils is medium to high ranging from 18.0 to 56.8 % as most of them are originated from shale. The CEC of the soils is low to medium 6.6 to 20.6 cmol (p+) kg $^{-1}$ and the soils are very poor base saturated. The exchangeable Al content is relatively high ranging from 1.9 to 6.3 cmol (p+) kg $^{-1}$ which increases with depth.

Land capability

The region has been broadly categorised into Class II, Class III and Class IV respectively.

Suitable crops

Tree

Arecanut, Coconut, Guava, Pomegranate, Peach, *Emblica officinalis* (Amla), *Saraca asoca* (Asoka), *Oroxylum indicum*, *Garcinia pedunculata*, *G. cowa*, Sapota, *Averrhoa cariambola* (Kamrenga), *Anona*, *Aegale*, *Flacourtia*, *Dillenia indica*, *Eugenia*, *Spondias*, Moringa, Tamarindus, Jackfruit, Mango.

Small tree

Papaya, *Citrus* sp. (13 spp.), Orange, Litchi, Guava, Pomegranate.

Shrub

Clerodendrum colebrokianum, Tree tomato (*Syphomendra betacea*), *Rauvalfia serpentina, R. tetraphylla, Vitex nigando, Phlogocanthus thyrsiflorus.*

Herb

Chillies, Cardamum, *Andrographis paniculata* (Kalmegh), Lemon grass, Patchouli, Citronella grass (*Cymbopogon winteriaruns* Jowitt), Banana, Pineapple, Bramhi (*Bacopa monnieri L).*

Climber

Grape, Black pepper (*Piper sp.*), *Tinaspora cordifolia.* Passion fruit (*Passiflora*)

Rhizome and Tuber yielding

Ginger, Turmeric, *Dioscorea alata.* Potato (Rabi) varieties (kufri – Jyoti), *Alocacia, Colocacia*, Sweet potato, Arrow root.

Cereals

Rice (kharif) varieties – IR –36, Mashuri, IET 6666, Bahadur, Local germ plasm, Maize (kharif & Rabi) Vairities – G 11, G 5, VC, Deccan 103; Wheat (Rabi) verities, RR 21, Sonalika; Millet (Khari) foxtail millet, ragi; Barley; Buckwheat.

Pulses

Legumes such as rice beans (*Lobia*), green gram (*Phaseolus aureus* Roxb.), winged beans (*Phosphocarpus tetragonolobus*), broad beans (*Vicia faba*), Dolichos (rabi), and sword beans includes *Shuteria spontaneum. S. longisetosus, S. procerum*, and *S. sikkimenses*; Pea (Rabi) rachna, bounnvilliae; Arhar (kharif) varieties T 22, ICPL 151, Parbhat; Soyabean (Kharif), varieties Bragg, PK 472, Rajmah

Oil seeds

Sesamum (Rabi), Rapeseeds M27, mustard; Varuna, Sunflower (*Helianthus annus* L.), Pinshing (Kalaktang), Ground nut, *Perila fruitescence.*

Subtropical (900-1800m msl)

Soil type

The soil types prevalent in the subtropical region are, Soil of warm per-humid, Eastern Himalayas, Soil of warm per humid, Siwalik Hill Ecosystem, Soils of warm per-humid, North-eastern Hills (Purvanchal) Ecosystem, Soil of hot humid, Plain Ecosystem.

Soils of warm per-humid, North-eastern Hills (Purvanchal)

Land capability

The region has been broadly categorised into Class II, Class III, and Class IV respectively.

Suitable crop

Tree

Apples, Plum, Pear, Cherry, Castonopsis tribuloidis, *Chest nut, Apricot, Almond, Pomegranate*, Garcinia, Artocarpus, Persia, Avocado, Eugenia, Ficus, Juglans, Syzygimum, Emblica officinalis.

Climber

Rubia cordifolia, Grape, Kiwi (Actinidia)

Shrub

Tapioca, Zanthoxylum.

Rhizome and tuber yielding

Ginger, Turmeric, Potato (Kharif & Rabi) varieties (kufri – Jyoti), Sweet potato *Ipomea*)

Herb

Swertia chirata, Chillies, Cardamum, Digitalis lanata, Bramhi (*Bacopa monnieri* L)

Cereals

Rice (kharif) varieties – IR –36, Mashuri, IET 6666, Bahadur, Local germplasm

Maize (kharif & Rabi) Varieties – G 11, G 5, VC, Deccan 103, Wheat (Rabi) verities, RR 21, Sonalika, Millet (Kharif) foxtail millet, ragi, Barley, Buckwheat

Pulses

Legumes such as pigeon pea, rice beans, green gram, winged beans, broad beans, Dolichos, and sword beans includes *Shuteria spontaneum, S. longisetosus, S. procerum*, and *S. sikkimenses*; Pea varieties rachna, bounnvilliae; Arhar varieties T 22, ICPL 151, Parbhat; Soyabean (Kharif), varieties Bragg, PK 472,

Oil seeds

Sesamum (Rabi), Rapeseeds M27, mustard; Varuna, Sunflower (*Helianthus annus* L.), Palmarose, *Xanthoxylum* (Thimru oil), *Litsea citrata, Mentha*, Bulgarian rose, *Geranium*.

Vegetable

Brinjal (*Solanum* sp.)

Temperate (1800 - 3500 m msl)

Soil type

Soil of warm per-humid, Eastern Himalayas, Soils of warm per-humid, North-eastern Hills (Purvanchal) Ecosystem, Soil of hot humid, Plain Ecosystem.

Land capability

The region has been broadly categorised into Class III, Class IV, Class VIII

Suitable crop

Tree

Apple, Cherry, Walnut, Chesnut, Pomegranate, *Illicium grifithii. Taxus baccata,*

Shrub

Berberis aristata

Herb (ground canopy)

Coptis teeta. Swertia chirata, Panax sikkimensis, Panax sp., Digitalis lanata

Climber

Rubia cordifolia. others..

Rhizome and Tuber Yielding

Potato, others.

Cereals

Rice, Maize, Millet, Barley, Buckwheat.

Pulses

Green gram (*Phaseolus aureus* Roxb.), Lentil (*Lens culinaris* Medik. Syn. *L. esculenta* Moench), rice beans, winged beans, broad beans, Dolichos, and sword beans includes *S. spontaneum, S. longisetosus, S. procerum,* and *S. sikkimenses*; Pea; Arhar, Soyabean, etc.

Oil seeds

Sunflower (*Helianthus annus* L.)

Alpine (> 3500 m msl)

Soil type

Soil of warm per-humid, Eastern Himalayas, Soil of hot humid, Plain Ecosystem.

Land capability

The region has been broadly categorised into Class IV and Class VIII respectively.

Suitable crops

Tree

Rhododendron anthopogon, Juniperus indica

Herb

Nardostachys jatamansi, Picrorrhiza kurroa, Aconitum ferox, A. heterophyllum, Gentiana sp. Sassia wallichii, Fritillaria, Hypericum, Swertia, Helinia, Bergenia,

Tuber yielding

Gymnadaenia orchidis

Cereal

Barley (*Hordeum vulgare* L.)

Cultural requirement for Agriculture, horticulture and forestry species.

Horticultural crops, Cultural requirement and intercrop species

Species	Elevation, msl	Cultural requirements	Intercropping
Apple	915-1800	Well drained fertile deep soil with pH5.8-6.2, 21-26.7^0 C temperature, 10-12.5 cm rainfall	Beans, seasonal vegetables
Walnut	<1830	Red lateritic soil with pH ranges from 5.2-6.8, 2-20^0 C, 90-100 cm rainfall	Pulses and vegetable during initial stages of crop growth
Pear	900-1800	Sandy loam to clay loam with pH 6.0-6.8, 90-100 cm rainfall	Pulses and vegetables
Plum	500-2400	Sandy clay to clay loam with pH 6.0-6.8, 11-20^0 C, 90-100 cm rainfall	Pulses and vegetables
Peach	900-1800	Sandy loam soil with pH 5.5-7.5, 10-25^{0}C, 90-100 cm rainfall	Pulses and vegetables
Mandarin	600-1500	Medium or light loam soil with pH 5.5-8.0, 10-30^0 C, 75-250 cm	Pulses and vegetables
Mosambi	600-1800	Heavy clay to light sandy soil with pH 6.0-8.0, 10-30^0 C, 50-100 cm	Leguminous crops and vegetables
Lemon	<1200	Well drained shallow soil with pH 5.5-6.0, 15-35^0 C, 75-250 cm rainfall	Chilli, papaya, brinjal
Pineapple	170 - 915	Light to medium soil, pH 5.5 -6.0, 21-23^{0}C, 150 cm rainfall	Pulses and vegetable
Banana	170 -915	Well drained loamy soil with pH ranges from 6.0-8.0, 10-40^0 C, 200-300 cm	Brinjal, Colocasia, turmeric, chilli, okra, pineapple
Pomegranate	915-1800	Loam or alluvial soil with a pH ranges from 6.5 to 7.8, 20-38^{0}C, 100-200 cm	Cabbage, tomato, radish, cucurbits
Grape	915-1800	Porous loose friable soil with pH 6.5-8.5, 10-40^0 C, 24-40 cm rainfall	Pulses and vegetable during initial stage of crop growth.
Kiwi	900-1800	Deep loamy soil with pH ranges from 5.0-6.0, 4.0-35^{0}C, 150 cm rainfall	Strawberry, tomato, brinjal, cabbage, pulses etc.

Guava	<1000	Well drained sandy loam to clay soil with pH 4.5-8.5, 23-28°C, 120-200 cm rainfall	Brinjal, bhindi, leguminous crops, radish
Litchi	170-915	Loamy soil with pH 5.5-6.0, 10-28°C, 130-200 cm rainfall	Cucurbits, radish, pulses, papaya, pineapple etc.
Papaya	<1200	Well drained sandy loam soil with pH ranges from 6.0-7.0, 20-26°C, 150-180 cm rainfall	Cabbage, cauliflower, onion, chilli, tomato
Strawberry	< 3500	Well-drained medium loam with pH 5.7-6.5, 10-30° C, 50-100 cm rainfall.	Chilli, radish, onion, pulses
Arecanut	170-915	Well drained loam soil with pH ranges from 5.5-6.0, 10-38° C 200-300 cm rainfall	Banana, betelvine, pineapple, chilli, turmeric

Agricultural crops, cultural requirement and intercrop species

Species	Elevation in m	Cultural requirements	Intercropping
Wheat	<3300	Sandy loam, 15-25° C, cool winters, bright sunny days with lower humidity	Legume, mustard, linseed, chickpea
Maize	<3000	Loam to silty loam soil with pH range of 6.5-7.5, 15-32°C, 50-75 cm. rainfall	Cowpea, chickpea, rice bean
Paddy	<3000	Heavy clay, clay, clay loam or silty loam soil with pH ranges from 4.5-8.5, 5-38°C, 80-400 cm rainfall	Soybean, pulses
Sorghum	<1500	Clay loam to loam soil with pH 5.5-8.0, 26-30° C, 40-100 cm rainfall	Legumes, oilseeds
Barley	<4000	Sandy loam to heavy loam soil with pH ranges from 6.5- 8.5, 12-30°C, 25-50 cm rainfall	Legumes
Bajra	<3000	Light texture soil with pH 6.5 - 8.5, 12-30° C, 40-75 cm rainfall	Legumes, potato
Finger millet	<2100	Well drained loam to clay loam soil with pH ranges from 5.0 - 8.0, 50-100 cm rainfall	Legumes, oilseeds, maize, potato
Buckwheat	<3000	Poor soil with wide pH range of 5.4-6.5, 7.2-25°C, 10-30 cm	
Job's tears	<2500	Clay loam to loam soil with pH 5.5-8.0, 26-30° C, 40-100 cm rainfall	Pulses
Green gram	<2000	Well drained loamy to sandy loam soil with pH 4.7-7.5, 60-75 cm rainfall	Potato, laipatta, mustard, vegetables
Black gram	<1800	Well drained loam soil with pH 4.7-7.5, warm weather crop, 60-80 cm rainfall	Sorghum, maize, peas
Rice bean	<1800	Well drained sandy loam with pH 6.5-7.5, 15-35° C, 50-150 cm rainfall	Maize, finger millet, beans
Pigeon pea	<1500	Sandy loam to clay loam soil with pH 6.5-7.5, 15-35°C, 60-80 cm rainfall	Maize, finger millet, beans, turmeric, ginger
Chick pea	<1500	Sandy loam to clay loam soil with pH ranges from 5.5-8.6, 60-100 cm rainfall	Maize, bajra, sorghum
Cowpea	<1800	Well drained loam to moderately heavy soil with pH ranges from 6.0 -7.5, 12-35°C, 50-100 cm rainfall	Other pulses
Pea	<1600	Sandy loam to sandy clay loam soil with pH 6.5-7.5, 10-18°C, 25-50 cm rainfall	Chick pea, barley, rapeseed and mustard
Dolichos bean	<1500	Loam to silty loam soil with pH 5.5-6.0, 10-30°C, 25-70 cm rainfall	

Soybean	<2000	Well drained fertile sandy loam to loam soil with pH ranges from 6.0-7.5, 10-30^{0}C, 60-80 cm rainfall	Maize, other pulses
Rajmah	<1000	Deep light textured soil with pH 6.5-7.5, mild temperature with high rainfall	Maize, sorghum, bajra, Sesamum
Lentil	<3000	Light loam textured alluvial soil with pH ranges from 4.5-8.2, 18-30^{0} C	Maize, barley, linseed, sorghum, rapeseed & mustard, bajra
Sesamum	<1300	Well drained sandy loam soil with pH ranges from 5.5-8.2, 25-27^{0}C . 150-160 cm rainfall	Pulses, maize, sorghum, bajra
Rapeseed and mustard	<3000	Light to medium loam soil with neutral pH, 18-25^{0}C, 25-40 cm rainfall	Pulses, maize, sorghum, bajra
Linseed	< 770	Well drained loam to clay loam soil with a wide pH range, 21-26^{0}C, 45-70 cm rainfall	Pulses, maize, sorghum, bajra
Sunflower	<1500	Well drained sandy loam soil with pH ranges from 6.5-8.5, 18-22^{0}C	Maize, millets, pulses,
Cabbage	<1800	Sandy loam soil with pH 5 5-6.5, 15-20^{0}C, 25-50 cm rainfall.	Chilli, radish
Cauliflower	<1500	Sandy loam to clay loam soil with pH ranges from 5.5-6.5, 15-25^{0}C, 25-50 cm rainfall.	Chilli, radish
Broccoli	<1500	Sandy to silt loam soil with pH 5.8-7.2, 15-25^{0}C, 25-50 cm rainfall	Chilli, radish
Carrot	<1500	Well drained deep loose loam soil with pH ranges from 6.0-6.5, 15-20^{0}C, 25-50 cm rainfall	Chilli, radish
Radish	<1800	Well drain sandy loam soil rich in organic matter having pH ranges from 5.5-6.8, 10-15^{0} C, 25-50 cm rainfall.	Chilli, potato, onion
Spinach	<1800	Sandy loam to clay loam with pH ranges from 6.0-7.0, 10-15^{0} C, 25-50 cm rainfall.	Chilli, carrot, radish,onion
Sweet potato	<900	Sandy loam soil with pH 5.2-6.7, 20-30^{0}C, 75-150 cm rainfall	Leguminous green manure crops, colocasia
Tapioca	<1000	Light sandy loam to loam soil with mild acidic soil reaction, 25-29^{0}C, 100-150 cm rainfall.	Upland rice, maize, finger millet, yam, sweet potato, ginger, chilli, leafy vegetables
Brinjal	<1500	Loam to clay loam soil with pH 5.5-7.0, 13-25^{0}C, 50-100 cm rainfall	Chilli, radish
Turnip	<1800	Sandy soil with pH 5.5-6.8, 10-15^{0} C, 25-50 cm rainfall	Cabbage, cauliflower, Laipatta, potato, chilli
Cucumber	<1800	Sandy loam to silty loam with pH ranges from 5.5-6.7, 18-24^{0}C, 50-150 cm rainfall.	Pumpkin, chilli, radish, potato
Bitter gourd	<1500	Loam to silty loam soil with pH 6.0 to 7.0, 18-24^{0}C, 50-150 cm	Cucumber, ridge gourd, chilli
Bottle gourd	<1800	Sandy loam soil rich in organic matter with pH 6.0-7.0, 15-35^{0} C, 50-150 cm rainfall.	Chilli, Cucumber, ridge gourd
Pumpkin	<1800	Sandy loam to clay loam with pH ranges from 6.0-6.5, 15-30^{0} C, 50-100 cm rainfall	Potato, radish, cucumber
Colocasia	<1500	Loam to silty loam soil with pH 6.0-7.2, 10-30^{0} C, 50-100 cm rainfall	Maize, finger millet, yam, sweet potato, ginger, chilli, leafy vegetables
Yam	<1500	Loose, deep and well drained fertile soil with pH 6.0-7.2, 10-30^{0} C. 50-100 cm rainfall	Maize, finger millet, colocasia, sweet potato, ginger, chilli, leafy vegetables
Tomato	<1500	Loam to silty loam soil with pH ranges from 6.0-7.0, 20-30^{0}C, 25-50 cm rainfall.	Chilli, onion
Potato	<2000	Sandy loam to clay loam soil with pH 5.5-6.5, 10-26.6^{0}C, 25-50 cm rainfall.	Maize, pulses, oilseeds

Chilli	<1500	Well drained sandy or clayey loam, 20-30^0 C, 60-150 cm rainfall	Radish, pulses, onion
Bhindi	<1800	Sandy loam to clay loam with pH ranges from 6.0-6.8, 20-35^0 C, 50-150 cm rainfall.	Chilli, brinjal
Laipatta	<1800	Well drained sandy loam to clay loam with pH ranges from 6.0-7.0, 15-25^0 C, 25-50 cm rainfall.	Potato, cabbage, rabi pulses
Turmeric	<1500	Well drained loam to clay loam soil rich in organic matter, 20-30^0 C, 150-300 cm rainfall	Pigeon pea, maize, chilli
Cardamom	600-1300	Loamy to red deep lateritic soil, 10-35^0 C, 150-400 cm rainfall	Pine, as multi-storeyed crop
Ginger	<1500	Sandy to clay loam with pH 4.5, 28-35^{0}C, 100-150 cm rainfall.	Pigeon pea, Tapioca, maize, chilli
Onion	<2000	Sandy loam to silty loam with pH ranges from 5.8-6.5, 15-26^{0}C	Chilli, potato radish, cabbage,
Black pepper	<1000	Well drained alluvial soil, pH 4.5-6.0, 10-40^0 C, 125-200 cm rainfall	
Garlic	<2000	Sandy loam to silty loam soil rich in organic matter with pH ranges from 5.5-7.0, 10-25^{0}C, 100 cm rainfall.	Onion, radish, potato, cabbage

Medicinal plants

Species	Elevation in m	Cultural requirements
Aswaganda	<900	Sandy loam to light red soil with pH 7.5-8.0
Sarpagandha	<1500	Sandy loam to clay loam, 10-18^{0}C,
Kutki	2700-4500	sandy loam soil
Asoka	<720	Lateritic loamy soil
Mishmi teeta	<1800	Rich humus soil with pH from 5.5-7.0, 10-25 ^{0}C, 50-100 cm rainfall.
Lishi	2000-3000	PH 4.5-6.5
Ginseng	1500-3000	Well drain soil with high organic matter with pH 5-6, 0.9-25^0 C, 120 cm rainfall
Himalayan Yew	<1800	Soil with pH 5.0.6.8
Jatamansi	3000-5000	pH 5.0-6.0
Geranium	<2000	Well drained less fertile sandy loam soil with pH 6.0-8.0, 15-20^{0}C, 150-180 cm rainfall
Patchouli	<900	Well drained soil rich in humus with pH ranging from 5.5-6.5, 22-32^{0}C, 150-300 cm rainfall
Aconitum	1800-4500	Well drained moist soil pH 4.6-5.5, 10-15^{0}C, 23-100 cm rainfall
Chirata	1300-3000	2-28^{0}C
Bramhi	<1200	Waterlogged soil
Shatavari	<2000	Sandy loam soil with pH 6.0-7.0
Cinchona	800-2800	Loamy to clayey loam soil with pH4.5-6.0, 150 cm rainfall.
Isabgul		Well drained sandy loam soil with pH ranges from 6.5-7.5

Forestry species

Species	Elevation	Cultural requirements
Pine	<3000 m	Red sandy to red loamy with pH 5.5-6.5, 10-25^0 C, 20-50 cm rainfall
Alnus	900-2700 m	pH 6.1-8.1, 95-400 cm rainfall, 13.5-18.0^0 C
Oak	900-2700 m	4.5-6.5, 10-20^0 C, 45-380 cm rainfall,
Sisso	<1400 m	Alluvial soil, 10-35^0 C, <300 cm rainfall
Gamari	<1200 m	18-33^0 C, red lateritic soil with pH ranging from 5.5-6.8, <250 cm rainfall
Teak	<900 m	Red lateritic soil with pH 5.5-6.8, 10-35^0 C, <250 cm rainfall
Albizia	900-1800 m	10-25^0 C, <200 cm rainfall
Khokan	<1500 m	10-30^{0}C, <300 cm rainfall

Crop calendar for agricultural crops

Species	Months											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Pa Jhum			★ ★	★ ★					× ×	× ×		
Settled	× ×	★ ★				★ ★	★ ★	★ ★			× ×	× ×
Maize		★ ★	★ ★			× ×	× ×					
Wheat			× ×	× ×						★ ★	★ ★	
Sorghum	★ ★	★ ★			× ×	× ×						
Barley	× ×	× ×		★ ★	★ ★		× ×	× ×	× ×	★ ★	★ ★	
Bajra						★ ★	★ ★		× ×	× ×		
Finger millet					★ ★	★ ★	★ ★		× ×	× ×		
Job's tears				★ ★	★ ★			× ×	× ×			
Green gram					★ ★	★ ★			★ ★	★ ★		
	× ×	× ×										
Black gram					★ ★	★ ★			★ ★	★ ★		
	× ×	× ×							× ×	× ×		
Pigeon pea				★ ★	★ ★					× ×	× ×	
Rice bean				★ ★	★ ★		× ×	× ×	× ×			
Chick pea		× ×	× ×							★ ★	★ ★	
Cowpea				★ ★	★ ★		× ×	× ×				
Pea	× ×	× ×							★ ★	★ ★		× ×
Dolichos bean	× ×						★ ★	★ ★			× ×	× ×
Soybean					★ ★	★ ★			× ×	× ×		
Rajmah		× ×	× ×							★ ★	★ ★	
Lentil		× ×	× ×							★ ★	★ ★	
Sesamum								★ ★	★ ★		× ×	× ×
Rapeseed and			× ×							★ ★	★ ★	
mustard			× ×							★ ★	★ ★	
Linseed		× ×	× ×						★ ★	★ ★	★ ★	
Sunflower		★ ★	★ ★			★ ★	★ ★			★ ★	★ ★	
		× ×	× ×						× ×	× ×		

× harvest, ★ sowing

Crop calendar for horticultural crops

Species	Months											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Fruits												
Apple												
Walnut												
Pear												
Plum												
Peach												
Mandarin	× ×				★ ★	★ ★	★ ★	★ ★			× ×	× ×
Mosambi	× ×			★ ★	★ ★	★ ★					× ×	× ×
Lemon					★ ★	★ ★	★ ★	★ ★				
							× ×	× ×	× ×			
Pineapple				★ ★						★ ★		
							× ×	× ×	× ×			
Banana			★ ★	★ ★								
	× ×	× ×	× ×	× ×					× ×	× ×	× ×	× ×
Pomegranate												
Grape	★ ★	× ×	× ×	× ×						★ ★	★ ★	★ ★
Kiwi		★ ★	★ ★							× ×	× ×	× ×

× harvest, ★ sowing

Identification of Crops as Alternate to Jhum

Continued

	Months											
Species	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Guava					* *	* *						
Litchi								* *	* *			
Papaya				* *	* *	* *						
Strawberry	x x	x x	x x	x x					* *	* *		
Arecanut					* *	* *				x x	x x	x x
Vegetables												
Cabbage									* *	* *	* *	
Cauliflower									* *	* *		
Broccoli												
Carrot										* *	* *	
Radish								* *	* *	* *	* *	
Sweet					* *	* *			* *	* *		
potato	x x							x	x x			x
Tapioca	x x	x		* *	* *							x x
Brinjal	* *	* *										
Turnip												
Cucumber			* *	* *							* *	* *
Bitter gourd						* *	* *			* *	* *	
Ridge gourd	* *	* *	* *	* *	* *							
Bottle gourd		* *	* *			* *	* *			* *	* *	
Ash gourd		* *	* *	* *								
Pumpkin	* *	* *	* *	* *					* *	* *		
Squash	* *	* *							* *	* *	* *	
Colocasia	x x			* *	* *	* *					x x	x x
Yam			* *	* *	* *						x x	x x
Tomato										* *	* *	
Potato		* *	* *				x x	x x				
summer		* *	* *									
Winter		x x	x x						* *	* *		
Chilli	* *										* *	* *
Bhindi	* *	* *	* *	* *	* *	* *	* *					
Spinach									* *	* *	* *	* *
Laipatta	x x							* *	* *		x x	x x
Spices and condiments												
Lishi				* *	* *	* *				x x	x x	
Turmeric			* *	* *							x x	x x
Cardamom						* *	* *			x x	x x	
Ginger			* *	* *						x x	x x	
Onion	x x	x x							* *	* *		x x
Black pepper	x x	x x	x x		* *	* *						
Garlic	x x	x x							* *	* *		x x

x harvest , * sowing

Cropping system

Various cropping practices such as mixed cropping, inter cropping, raw cropping, strip cropping, relay cropping, cover crops etc. would be attempted depending on the suitability of the agroclimate. In the agriculture farming following cropping system and sequences is being planned.

a. Rice and arhar crop combination in kharif season

b. Potato and pea in rabi season

c. Maize and soyabean combination in kharif season

d. Maize and pea combination in rabi season

Potato and pea or /beans in rabi

Management practice

Management practise in Jhum cultivation areas varies the community, the Noctes of Changlang district and Nishi of West Kameng district of Arunachal Pradesh pollard Macaranga denticuluta trees at the time of clearing the forest, and when they vacate the area they sow seeds of the these trees in blank areas so that they will be able to provide house building material and firewood when the community return back to the same Jhum areas.

In West Africa the shifting cultivation-cropping year increased from 5 to 8 years while the fallow period has reduced from 14 to 5 years1 [1]. This process has increased erosion, mined soil fertility, provokes build up of weeds and other pests, denuded large areas of natural vegetation, and reduced production potential.

Published literature reveals that several legume cover crops suppress weed growth and enhance soil fertility. Nitrogen accumulation by legumes has reported to vary from 1-270kg/ha with 30-90% derived from biological nitrogen fixation (BNF). Management of fallow with legume crops has increased rice yield about 30% over natural weedy fallow[1]. Frequently selected fallow legumes included *Tephrosia villosa*, *Crotolaria juncea* and *Cajanas cajan* in the forest.

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[1] West Africa Rice Research Brief No. 2 ,1999. Cover legumes increase productivity of upland rice under intensified land use

8

Organic Farming in Arunachal Pradesh

Organic farming

Organic farming is a crop production method respecting the rules of nature. The concept of organic farming is to demonstrate the effectiveness of low cost agriculture using locally available farmyard manure thereby increasing the net earnings from successive crops. It is a farming system that seeks to avoid the use of chemical fertilisers and pesticides.

Organic foods are distinguished from non-organic foods by the methods used in their production and processing, rather than by observable or testable characteristics. The internationally accepted rules for organic production prohibits use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives, and require long-term soil management, emphasis on animal welfare, and extensive record keeping and planning. In addition, certain activities such as use of genetically modified stock, application of sewage sludge to organic acreage, and food irradiation are also prohibited.

Organic agriculture relies largely on locally available resources and is dependent upon maintaining ecological balances and developing biological processes to their optimum. The protection of soil and the environment is fundamental to organic farming.

Organic farming is targeted to produce nutritive, healthy and pollution free food. It maximises the use of on farm resources and minimises the use of off-farm resources.

Objectives

- To produce healthy, nutritious and quality food.
- To encourage and enhance biological cycles involving microorganisms, soil flora and fauna, plants and animals.
- To maintain and enhance long-term fertility of soils and soil and water conservation.
- To minimise soil and water pollution that may result from agricultural practices.
- To use on farm resources as far as possible.
- To preserve and enhance traditional and indigenous knowledge in farming, seeds and varieties considering social and ecological impact of farming system

Minimum requirements for organic farming

In organic farming system, certain minimum requirements are to be met to fulfil its objectives, where the farm can be certified as organic.

Conversion

When a farmer switches over to the system of organic farming from the conventional system of farming, it is known as conversion. The time between the start of organic management and certification is called conversion period. The conversion period is decided based on the past use of the land and ecological situation. Generally, the conversion period is two years for annual crops and three years for perennial crops. However, the conversion period can be relaxed based on the verification by certification agency if the requirements are fully met.

Mixed farming

Animal husbandry, poultry, fisheries, etc. should be practised in addition to agricultural farming. Shifting cultivation is not allowed.

Cropping Pattern

Crop rotation should be followed if annual crops are grown. Intercropping should be practised when perennial crops are grown. Crop rotation should cover green manure as well as fodder crops. In case of perennial crops, cover crops should be grown to protect the soil. Monocropping should be avoided.

Planting

Species and varieties cultivated should be adapted to soil and climatic condition and resistant to pests and diseases. Seeds/Planting materials should be procured from organic source. If not available, chemically untreated seeds/planting materials can be used one time use of genetically engineered seeds or planting materials such as tissue culture, pollen culture, and transgenic plants is not allowed.

Manurial Policy

Soil fertility should be maintained/enhanced through raising green manure crops, leguminous crops etc. The residues of plants after harvest should be incorporated into the soil as far as possible. Biodegradable materials of microbial, plant or animal origin shall be applied as manures. (eq. compost, Vermicompost, farmyard manure, etc.). The mineral based materials like rock phosphate, gypsum, lime, etc. can be applied in limited quantities when there is absolute necessity.

Pest, Disease and Weed management

Use of synthetic/chemical pesticides, fungicides and weedicides is prohibited. Natural enemies shall be encouraged and protected. (for e.g. raising trees in the farm attracts birds, which kills pests of the crops, nest construction etc.) Products collected from the local farm, animals, plants and microorganisms and prepared at the farm are allowed for control of pests and diseases. (eq. Neem oil and other neem preparations like Neem seed kernel extract). Slash weeding is to be done between the plants. Weeds under the base of the plants shall be cleaned and put as mulch around the plant base. The weeded materials should be applied as mulch in the ground itself.

Soil and water conservation

Measures like stone pitching/contour wall constructions are to be taken up to prevent soil erosion. Judicious irrigation is to be practised. Mulching is required. Clearing of primary forest is prohibited. Cleaning of land through straw burning should be restricted to minimum.

Contamination control

It is necessary to take the following measures to minimise the contamination from outside and within farm.

- If neighbouring fields are non-organic, a buffer zone should be maintained. The height of buffer crop shall be twice the height of organic crop and the width of the buffer shall be 25-50 feet. (When chilli is grown as the main organic crop, castor or *Sesbania* can be grown as buffer crop. The crops from the buffer zone should be sold as non-organic).
- If the farm is under conversion, equipments used for conventional areas shall be well cleaned before using for organic areas.
- Products based on polythene, polypropylene and other polycarbonates are allowed to cover protected structure, insect netting, nursery, drying, etc. subject to the condition that these materials shall be removed from the field after use and they shall not burnt or put in the soil. Use of polychloride based products like PVC pipe is prohibited.

Processing

Processing technologies like solar drying, freeze drying, hot air chambers are permitted. Irradiation of agricultural produce is not permitted. No synthetic additives/dyes are to be added during processing.

Labelling

The label should convey clear accurate information on the organic status of the product. (i.e., conversion in progress or organic). The labels for organic and conversion in progress products should be distinguishable by different coloured labels. The details like name of the product, quantity of the product, name and address of the producer, name of certification agency, certification, lot number etc.

are to be given in the label.

Packaging

For packing, recycling and reusable materials like clean jute bags shall be used. Use of biodegradable materials shall also be used. Unnecessary packaging material should be avoided. Organic and non-organic products shall not be stored and transported together except when labelled.

Social Justice

Social rights and justice are an integral part of organic agriculture. The laws relating to labour welfare and rights of children should be honoured. All employees and their families should have access to potable water, food, housing, education, transportation and health services. All employees should have equal wages when doing the same job. The rights of indigenous people should be respected.

Documentation

Documentation of farm activities is a must for acquiring certification especially when both conventional and organic crops are raised. The following documents/records are to be maintained.

Certification Process

Certification of organic farms is required to satisfy the consumers that the produce is totally organic. Certification agency conducts the inspection for organic certification of the agricultural produce to its fullest requirements.

The producer makes contact with certifying agency. Certification agency provides information on standards, fees, application, inspection, certification and appeal procedures. The producer submits an application along with field history, farm map, and record keeping system etc. whereupon the contract indicating scope, obligation, inspection and certification, sanction and appeals, duration, fee structure is executed.

The Inspector of the designated agency comes and carries out the inspection. The Inspector provides the inspection report with his recommendation to the agency, Then the agency issues approval or denial of certificate. Certificate is given for current year's harvest only and hence annual certification is required.

The International Federation for Organic Agricultural Movement (IFOAM), Basic Standards summarize the principal aims of *organic agriculture and Food processing as follows:*

- To produce food of high nutritional quality in sufficient quantity;

- To interact in a constructive and life enhancing way with all natural systems and cycles;
- To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals;
- To maintain and increase long-term fertility of soils;
- To use, as far as possible, within a closed system with regard to organic matter and nutrient elements;
- To work, with materials and substances which can be reused or recycled, wither on the farm or elsewhere;
- To give all livestock life conditions which allow them to perform the basic aspects of their innate behaviour.
- To minimise all forms of pollution that may result from agriculture practice;
- To maintain the genetic diversity of the agricultural system and its, surroundings, including the protection of plant and wildlife habitats;
- To allow agricultural producers a life according to the UN human rights, to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment;

To consider the wider social and ecological impact of the farming systems.

Organic Farming in Arunachal Pradesh

Scope

In Arunachal Pradesh fertilizers and pesticides consumption is very low and particularly in jhum land farmers hardly use fertilizers and pesticides. They prefer to use some organic manures particularly of plant origin. Hence with the existing system of farming, there is a possibility of producing organic fruits and vegetables. There is a huge demand for Organic food in the West. With the WTO regulations coming into force from 2004 onward, the huge subsidies given to Agri and allied sector in the developed countries will go. This will result in spectacular demand for horticultural products particularly organic product from India. In Arunachal Pradesh, horticulture products are more or less organically produced which can fetch a higher price in national as well as international markets.

Approach

It is a challenge to adopt organic farming in Arunachal Pradesh due to its diverse germplasm of agricultural crops, poor productivity, and reduced fallow period for Jhum cultivation and delicate agro ecosystem. Reports of various agencies (DHO, DES) published on agricultural management practices in Arunachal Pradesh reveals diversified crops with low input of synthetic fertilizer. This very fact can be encashed for organic farming fulfilling the IFOAM standard guidelines. Therefore, in Arunachal Pradesh the suitable approaches for establishing organic agriculture can be drawn as follows.

- Crop rotation and diversification would be a key principle in an ecological farming system
- In an annual cropping system: legumes can be used as green manures and cover crop.
- Use of allelopathic crops that exude toxins from their roots can help in suppressing weeds and insect pests.
- Diversity of crops in both time and space can help prevent insect and disease build-up and provide a hedge against poor market conditions for one crop.
- Leguminous cover crops in a perennial or permaculture system can hold the soil, improve fertility and host beneficial insects.
- In farming systems, a diversity of plants using different components such as polycultures, hedgerows and windbreaks can help ensure a balance in the system where one factor such as a pest or a weed can throw the system off balance.
- Pest-free and weed-free fields are neither possible nor economically and ecologically desirable. Traditional pest management practices can be an ideal mechanism for controlling, insects, birds and rodents over time and can be an ongoing process.
- Varietal selection should look beyond maximum potential yield and consider insect and disease resistance, nutritional quality, flavour and positive response to lower inputs of nutrients and water,
- Materials are not used as the primary management strategy, but rather as an aid to resolving a specific problem until the farm system can be brought back into balance
- Low input of synthetic fertilizer in the traditional farming can be an advantage for a shift towards complete organic farming.
- Because pests need to be managed rather than eliminated, partial crop losses have to be accepted, and sometimes initially total failure may occur

The following guidelines shall be practised for efficient organic farming

Soil nutrient management:

- Nitrogen: Green manure and leguminous cover crops; bacterial inoculants to soil, legumes and compost;
- Phosphorus: Composed manures high in phosphorus (poultry, guano); colloidal, soft and hard rock phosphate, mycorrhizae to activate rock phosphate.
- Potassium: Cover crops that activate potassium, mined granite, greensand, basalt, feldspar, langbeinite and potassium sulphate.
- Secondary minerals (calcium, magnesium and sulphur), dolomite, gypsum, kieserite, langbeinite, limestone, potassium sulphate and rock phosphate from mined sources.
- Micronutrients (Boron, Copper, Iron, Manganese, Molybdenum, Zinc): rock powders, chelates made with natural chelating agents.
- Growth promoters, Activators and inoculants: Herbal preparations, rhizobial inoculant, biodynamic preparations, blue green algae, humates, naturally occurring microbes.

Weed management:

Weeds are prominent in the jhum field and reduce crop productivity by competing with the main crop if left unmanaged. Therefore, an integrated approach involving different weed management practices is desired to ensure better crop yield. In organic farming practice the following means can control weeds:

- Preventive method measures taken in this method do not allow the weeds to appear in the cropped area. Therefore, it is advisable to use clean seeds, avoid feeding of grains screening of a containing weed seeds, use of well rotten and decomposed organic manure.
- Mechanical: Method include hand pulling, hoeing, tillage, mowing, burning, mulching and is effective on annual weeds in which all the growing points can be buried. However burial is usually less effective on perennial weeds, which have underground propagules (stems and roots) and are capable of regeneration. Minimum tillage can reduce the growth of weeds having underground propagules. Mowing is most effective on tall growing annuals, since grasses grow from basal meristems, mowing is not usually an effective method. Perennial weeds that regrow from underground storage organs require frequent and usually long term mowing for control.

- Crop competition: is usually one of the cheapest and best methods of weed control. Weeds compete with crops for space, light, moisture, nutrients, and carbon dioxide. Usually the plant, which starts first and is growing under ideal conditions, will have the competitive advantage. Factors such as planting date, row spacing, seeding rate, planting depth, soil moisture, soil fertility, and soil pH have an influence on the competitive advantage of the crop on weed.
- Crop rotation: crop rotation; reduce the population of specific weeds, which were tolerant in the previous cropping season.
- Biological method: in this method a natural enemy of the weed plants mainly plant pathogens, nematodes, parasitic plants, and insects are used to reduce their number below an economically important level. Allelopathic weed control is a recently accepted technique in organic farming. There are many crops which exudes toxic chemicals that check weed growth in the agricultural field. For example, Sorghum (*Sorghum bicolor*) root exudates inhibit the pigweed growth (Alsaadawi et al., 1985[1]). Pigeon pea (*Cajanus cajan)* reduced weeds to the level where farmers do not weed at all (Hepperly et al. 1992[2]).
- Fire: Traditional firing methods on weed management can be an ideal solution in appropriate environment. Fire is usually more effective on annual weeds than on perennial weeds.

A better approach could be the utilization of integrated weed management (IWM) system that ensures sustainable crop production.

Integrated Pest management:

Disease management: Resistant varieties, sanitation, cultural practices that favour the crop, hinder the pathogen, and create an environment unfavourable for disease development; biological control agents; and least toxic chemicals derived from natural sources.

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[1] Alsaadawi, I. S.; J. K. Al-Uqaili; A. J. Al-Rubeaa; and S. M. Al-hadithy. 1985. Effect of gamma irradiation on allelopathic potential of sorghum against weeds and nitrification. J. Chem. Ecology. 12:1737-1745.

[2] Hepperly, P; H. A. Erazo; R Perez; M. Diaz; C. Reyes. 1992. Pigeon pea and velvet bean allelopathy. In: Rizvi, S. J. H. and V.Rizvi. 1992. Allelopathy: Basic and applied aspects. Chapman and hall, London. p.357-369.

Insect management: preventive management such as use of resistant varieties, timing to avoid cycles of pest emergence, intercropping, rotations, balanced plant nutrition, herbal sprays, rock powders, dormant oils, parasitic nematodes, introduction of predators, habitat enhancement to encourage beneficial predators, sticky traps.

9

Schemes for rehabilitation of the Jhum cultivators

A number of development programmes have been taken up during the last few decades in order to improve the socio-economic conditions of local communities and other weaker sections of society. Presently, at the national level, a number of ministries and departments are engaged in implementation of programmes and schemes using the watershed approach - the main ones being Ministry of Agriculture (MOA), Ministry for Rural Development (MORD) and Ministry of Environment & Forest (MOEF). Under the MOA, three main schemes namely; the National Watershed Development Project in Rainfed Areas (NWDPRA), the Watershed Development Project for Shifting Cultivation Areas (WDPSCA) in the north-eastern region and soil conservation in the catchments of River Valley projects and Flood Prone Rivers (RVP and FPRs) are being implemented. Under the MORD, four schemes namely; the Desert Development Programme (DDP) and the Drought Prone Areas Programme (DPAP), Integrated Wastelands Development Project (IWDP) and the Employment Assurance Scheme (EAS) are under implementation. An MOEF, namely the Integrated Afforestration and Eco-development Project Scheme (IAEPs) is being implemented on the watershed basis.

mon Approach for Watershed Programmes

An Inter-Ministerial Committee was constituted in 1999 for formulation of common approach for watershed development by examining the existing guidelines of watershed development projects and programmes of the MOA and the MORD. The areas of convergence and commonalities in approach in selection of rainfed areas for interventions through treatment, institutional framework and modalities of implementation based on earlier experiences has lead to the development of a "common approach for watershed development" programme. In 2000, a "Common Approach for Watershed Development" was jointly formulated and adopted by MOA and MORD, GOI incorporating the strength of the earlier first generation –based watershed programmes (MOA, 2000). The Planning Commission has also accepted the common approach for watershed development projects and based on the common approach, the MOA has restructured NWDPRA providing for decentralisation of procedures, flexibility in choice of technology and provision for active involvement of the watershed community in planning, implementation and evaluation of the programme so that it becomes sustainable (MOA, 2000).

Rehabilitation packages for Jhum cultivators in north east India

Focused rehabilitation package for Jhum cultivators in Northeast India was taken into consideration during the VIII the five-year plan period under the programme, Watershed Development project in shifting cultivation areas (WDPSCA). The scheme is being implemented under the 100% special central assistance to the state plan programmes. Schemes under the programme are taken up through government and non-government organizations, scientific and technical institutions in the North-Eastern States in watersheds where a minimum of 25% area is under shifting cultivation and 50% and above families are engaged in shifting cultivation as the only means of livelihood and are living below poverty line.

Another programme that is being implemented in the Shifting cultivation areas is the National Watershed Development Project in Rainfed Areas (NWDPRA) and both the programmes are under the aegis of the Ministry of Agriculture (MoA) and is being implemented under the guidelines for watershed Development with effect from 1995. Government Departments (Agriculture, Horticulture, Rural Development), scientific and technical institutions in the North-Eastern. Gram Panchayats/Village councils/Village Authority/Village Development Boards/NGOs belonging to the prioritised watersheds are eligible for selection of watershed projects under the jurisdiction to the District Nodal Officer. The Directorate of Agriculture is the State Nodal Office for implementing WSPSA and NWDPRA schemes in Arunachal Pradesh.

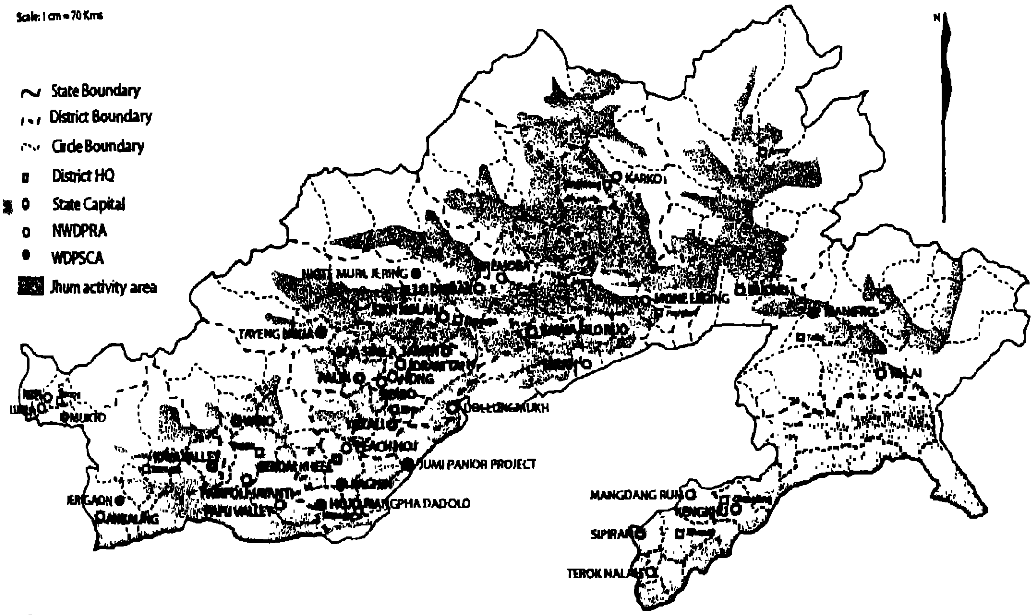
Watershed development project in Shifting cultivation areas (WDPSCA)

A total number of 15 micro-watersheds covering an effective area of 18892 Hectares have been brought under the treatments, which were initiated during the VIIIth plan period. The project period for the projects has been 1996-97 to 2001-2002. The WDPSCA schemes have been implemented in 8 districts of the state where 71 villages, with a population of 14288 numbers, benefited 3262 number of farm families. Observation of the scheme components in the watershed development activities exhibits a range of component in the interventions, ranging from non-arable conservation measures, treatment of arable land, enhancement of production systems, drainage line treatment, livestock management under a broad spectrum. It would be unjustified to comments on the approach that has been considered, but it is strongly felt that schemes for the benefits of the community should be community driven and local level Instutions which are important for the upkeep of the assets created should be given prior importance, and capacity building of the local level Instutions would be on of the basic approach towards sustainable management of the implemented schemes.

National Watershed development project for rainfed areas (NWDPRA)

The State Directorate of Agriculture. Govt. Of Arunachal Pradesh has initiated watershed development activities under the National Watershed Development project for rainfed areas (NWDPRA). twenty-two micro-watershed covering an effective area of 16219 hectares in twelve districts have been brought under various stages of treatment. The activities under the NWDPRA has been initiated under the IX plan in the state of Arunachal Pradesh since 1997 – 1998 to 2001 – 2002 and the scheme components implemented are similar to that implemented under WDPSCA package.

REHABILITATION PACKAGES FOR JHUM CULTIVATORS IN ARUNACHAL PRADESH



Source: Directorate of Agriculture, Govt. of Arunachal Pradesh, 2003

Establishment of credit and thrift societies, development of community Instutions and emphasis on training and awareness among the community does not get reflected. Therefore it has been observed that most of the infrastructure created through the process remains under-utilised once the implementing agency withdraws form the areas. This can be attributed to the approach in implementation guided by the watershed development guidelines of the supporting ministries.

Joint Forest Management

The Government of Arunachal Pradesh enacted the Anchal/Village Forest Reserve Constitution and Maintenance Act 1975, under this act only those areas which are willingly offered by the local communities are declared as Anchal Reserve Forest (ARF) / Village Reserve Forest (VRF) and these areas are being planted at government cost. The benefit share in the scheme is such that the income from such plantations is shared between the government and the local community on pre-arranged basis. Until date, 61,937 ha of land have been brought under ARF/VRF area.

The formal resolution of JFM was issued in the state in 1997 and at present 10 Village Forest Management Committees is managing 5.285 ha of forest land. Besides the unclassed forests would also be covered under this programme, where the envisaged benefits sharing would be as 25% of the gross benefits with the individual members, 25% to the committee fund and the remaining 50% to the state government (Moef.nic.in).

Forest Plantations

Forest plantation in Arunachal Pradesh has remained as a low-key activity due to its rich forest resources. During early 1950s, plantations started with some of the native species such as *Terminalia myriocarpa*, subsequently more native species (*Bombax ceiba, Dipterocarpus macrocarpus*) were added. Tectona *grandis*, has been planted to a limited extent. A total of 160,950 ha plantation has been taken up in the state between 1951 and 1999. The Plan-wise breakup of plantation is given in Table 9.1 Species wise breakup is, however not available.

Table 9.1· Forest plantations by all agencies

Period	Area in ha
1951 - 80	41.94
1980 - 85	25.59
1985 - 90	31.28
1990 - 91	05.61
1991 - 92	08.26
1992 - 97	40.25
1997 - 98	07.15
1998 - 99	00.92

Source: NAEB, MoEF, 1999

Integrated Afforestation and Eco-Development programmes are focused towards fuel wood and fodder plantation, conservation and development of non timber forest including medicinal plants, cultivation of ramie, integrated waste development programme and Samanvit gram Vanikaran Samirddhi Jogna.

State Govt.initiative towards development of horticulture

Development of horticulture in Arunachal Pradesh has been largely initiated through the Central support and State government initiatives. The interventions has been transferred to the filled through schemes supporting on

Field and farmer oriented programs ranging from maintenance of farm nurseries, kitchen garden, floriculture, fruit cultivation, plasticulture, establishment of nutritional garden, aromatic and medicinal plants, tissue culture, organic farming, spices, mushroom, beekeeping, etc. Where the achievements are presented in table .9.2

Table: 9.2: Field and farmer oriented programme

	Name of scheme	Plan year	Achievements
Directorate of Horticulture	Maintenance of farm nurseries	9th plan	302 ha. Interculture operations, planting materials
	Kitchen gardening and floriculture	9th plan	Flower seeds, fertilisers. Maintained at headquater
	Kiwi Cultivation	9th plan	36 ha, 2MT during 2000 - 2001
	Fruit cultivation	8th to 9th plan	3016 ha. 84940 MT during 8th Plan 89746 MT during 9th Plan
	Area expansion (Citrus)	8th & 9th Plan	7068 ha, 84940 MT (8th). 19147 ha (9th), 24000 MT
	Area expansion (Apple)	8th Plan	6186 ha. 145 MT (8th Plan), 11476 MT (9th Plan)
	Area expansion (Walnut)	8th & 9th	2038 Ha, 940 MT (8th). 2285 Ha, 754 MT (9th)
	Rejuvenation of old orchards	9th plan	80 ha, old orange orchards have been rejuvenated
	Maintenance of citrus garden	9th plan	Nafra (10 ha), Pampoli (0.4), Nacho (5 acres), Roing (10 ha), etc. (Annexure of schemes)
	Maintenance of apple garden	9th plan	Shergaon (120 ha),
	Mushroom development	9th plan	24000 kg Fresh mushroom , 3500 kg spawn
	Horticulture fair & exhibitions	2001-02	Tawang, Bomdial, Seppa, Ziro, Daporijo, Along, Yingkiong, Tezu, Itanagar, Khonsa, Changlang, Anini, Shergaon, Salari, Dirang, Kurung Kameng, Roing.
	Horticulture training	9th Plan	100 nos of trainees trained (2001-02)

Source: Directorate of Horticulture

Quality planting material (planting material, tissue culture, farm nurseries, horticulture farms)

	Name of scheme	Plan year	Achievements
Directorate of Horticulture	Nursery	9th plan	Intercultural operation, planting material, etc
	State horticulture farm in all the districts	9th plan	Rejuvenation of old orange orchards. Development of planting material for temperate fruits (Shergaon)
	Government horticulture farm	9th plan	Rejuvenation of old orange orchards. Development of planting material. 5.5 ha Grape & Kinnow (Salari)

Technology mission for integrated development of Horticulture

Owing to the diverse agro-climate conditions, horticulture has been identified as a mjor activity for the state. Having a Mission mode programme is vital for achieving desired goals. Accordingly the Technology mission for Integrated development of horticulture was formulated that would help in area expansion for fruits, vegetables, roots and tuber, spices, aromatic and medicinal plants, floriculture, mushroom, horticulture development Plasticulture integrated multicrop nursery, progeny herbal garden, tissue culture, transfer of technology, organic farming, promotion and popularisation of agriculture equipments, integrated pest management. The major objectives of the mission are.

- To establish convergence and synergy among ongoing governmental programme in the field of horticulture development to achieve horizontal and vertical integration of these programmes.
- To ensure proper linkage for timely and attention in production, post harvest and consumption chain.
- To maximise economic, ecological and social benefits from the existing investment and infrastructure created for horticulture development.
- Promote ecologically sustainable intensification, economically desirable diversification and skilled employment.
- To generate value addation, promote the development and dissemination of eco-technologies based on the blending of the traditional wisdom and technology with frontier knowledge such as biotechnology and information technology.
- To provide the missing link in the ongoing horticulture development projects.

Name of scheme	Mini Missions	Outlay
Technology Mission for integrated Development of Horticulture in North Eastern States including Sikkim	MM-I Research	Rs 2.50 cores for Research & Development
	MM -II Production and productivity	Rs 21.20 cores, quality production and productivity
	MM- III Post harvest management, marketing and export	Rs 10.80 cores, PHT, management & export.
	MM - IV Processing	Rs 28.00 cores for processing

State Schemes

Apna Van is a popular & successful scheme introduced in the recent past. Under this scheme a person or a family or a community can raise plantation on their fallow Jhum, waste land and degraded land with state govt under a subsidy of Rs. 2500/- per hec. The beneficiary can raise up to 5 ha per year & may continue 5 years at the same annual rate. In case of village community, 20 ha of plantation can be raised in a year and plantation programme may continue upto 20 years at the same annual rate. A beneficiary shall have absolute right on the forest produce including timber. The beneficiary and the Forest deptt. will fix the rotation of the crops for optimum benefit of the beneficiary.

M.N.P – This scheme is implemented with the objective of meeting over increasing fuel-requirement of the village community & plantation is raised in abandoned Jhum wasteland & degraded forest in vicinity of village community with the participation of poor villages. This afforestration not only will meet fuel requirement of the village community but also will improve ecological balance of the locality.

Centrally Sponsored beneficiary Schemes

Decentralised peoples Nursery

Under this scheme a person or (Kissan) a village community (Students) can raise nursery of economically important plants. Viable seeds and poly bags, chemicals etc are supplied, technical knowledge is provided by the forest Deptt. An individual can raise seedlings up to 25,000 in a year & can continue to work up to 3 years at the same rate. A group not less than 7 persons can raise up to 1 lakh seedlings and can continue the work up to 3 years. The central govt. would pay 70 paise for one seedling so raised by the person & the seedlings raised by the beneficiary will be purchased by the forest deptt.

Area-oriented fodder fuel wood plant, project :

Objective of the scheme is to produce more fuel wood & fodder plants in degraded & wasteland by involving public in afforestation works & for the betterment of their economic condition. Recently two afforestation programmes have been launched by the local tribal people of Arunachal Pradesh, under Dibang valley Forest Divn. local people are starting plantation on their own land which has been financed by the wood based industrialists trying up together to the effect that such plantation shall be raised by the village land owners and fund shall be provided by the industrialist on maturity of forest crops they shall be supplied to the concerned industries which financed the cost of raising and maintenance of the plantation. The village land owners are raising fast growing timber supply like kadam Khokon etc. where rotation shall be of 10 to 15 years.

The other organisation is the Monpa Social culture and Literary Society of Tawang District. The society has approached Govt. of India for financial assistance for raising 50 Ha of plantation during the current financial year has been sanctioned by the N.B.D.B Govt of India.

The above mentioned two non Govt. organisation schemed an Apna Van which will be an eye opener for the other tribal people and there is no doubt that more and more tribal will come forward to afforest their abandoned Jhum & waste land in the near future through which their economic condition will be developed and at the same time help society and the nation in greening the country which is an urgent national programme now. These schemes will also restore the traditional concept that the forest belongs to the tribals people & they will be protected by the concerned village community in future. So the entire forest management and its protection will be different from the present system in near future.

10

Desigining a location specific rehabilitation package

Land holding in the mountain areas are small and limited and ecological variability and diversity are large and hence developing strategies for sustenance for the mountain farming community is a challenging task. Research strategies therefore would essentially involve providing sustainability in totality by harnessing the ecological distinction in the mountains to its economic advantage.

Agricultural and development strategies in the mountains have been an extension of the lowland technologies, and hence economic viability of such technological inputs in mountain (steep land) farming systems becomes unsuitable. Therefore technological intervention in the mountain farming system essentially needs a better understanding of the present farming systems (Jhum & sedentary) through involvement of the primary stakeholder (farmer) who would help integrate the indigenous knowledge, heritage and values in the development initiatives. The proposed strategy would be a shift from the present system of unilateral research to that of a participatory research.

Communities residing in the mountain areas, often lack alternative resource for food production other than cultivating hill slopes for meeting their subsistence demands. Subsistence necessities and socio-political pressures make it impractical to expect farmers would refrain from cultivation in the hill slopes in the foreseeable future. In fact, the reality is that rapid expansion of agricultural activity on hill slopes is likely to continue. The rapid rate of deforestation and conversion of hill slopes for agriculture during recent decades, and the projected trends in tropical and subtropical regions, have become an international concern (FAO 1982, 1990; Moldenhauer and Hudson 1988, Aldhous 1993). In many instances, unstable land tenure is also the root cause of farmers' inability and unwillingness to risk investment in soil conservation (Pla Sentis 1992).

Soil erosion is the most significant ecological restriction to sustainable agricultural production on hill slopes. High intensity monsoon rains, combined with the runoff energy generated on steep slopes, contribute to high erosion rates. Forests, which originally provided cover of most steep land sites, helped to protect the soil by dissipating raindrop energy.

Soil erosion can have a devastating impact on the vast numbers of rural people who depend on rainfed agriculture in the mountain and hillside areas. Promoting integrated watershed development programmes through effective participation of local people is a key to preventing further ecological imbalance. An integrated approach is needed for conserving, upgrading and using the natural resource base of, land, water, plant, animal and human resources. In addition, promoting alternative livelihood opportunities, particularly through development of employment schemes that increase the productive base, will have a significant role in improving the standard of living among the large rural population living in the mountain ecosystems.

The management of farm land on mountain slopes essentially involves implementing practices designed to retain soil on the hillside through erossion controll measures againts the several erosional processes (interrill erosion, rill erosion, and mass wasting). Interrill erosion, can be controlled by maintaining cover on the soil which will intercept and dissipate the energy of a raindrop before it strikes the soil. Rill erosion, can be controlled by managing the soil to foster a high infiltration rate through land alternation that reduces the length and/or degree of slope, or by obstructing or impounding surface runoff. Mass wasting caused by the topsoil saturaturation can be controlled by impregnating the soil in place with deep-rooted plant species, or by installing physical barriers such as rock walls with foundations dug into the hillside. Conservation technologies would reduce soil and nutrient losses, and help preserve water holding capacity retain soil fertility for sustainable crop production. This can be made possible by incorporating data on climate, soil type, geology, rainfall, etc. for developing suitable conservation measures. In many instances, the use of conservation technologies may increase crop yields by 50% (Pimentel *et al.* 1995, Siebert and Belsky 1990).

Agro-forestry combined with traditional management system has been proposed as a sustainable model for the rehabilitation package. The model will combine the production of forestry, tree crops, herbs/ medicinal plants, cereals and vegetables according to altitudinal variations, crop plan/land availability and adoption of management practices that are compatible with cultural practices of the local communities with an overall objective towards enhancement of food, fuel wood and cash crops production. The systematic approach adopted would help in improvement soil fertility and the natural environment.

Cluster approach

The approach considered for winning away the Jhum & subsequent improvement of Farmer income has been proposed through the establishment of an agro-forestry (agriculture and horticultural farms) on a clustered approach as an alternative to shifting cultivation and has been based on an integrated watershed conservation and development approach with the treatment of micro catchments for effective implementation. This would be through individual programme under each village under the micro-catchments. Besides the approach does not take new land development such as terracing into consideration, but would prefer to continue appropriate land management practice on the topography with more ground cover that would help in

a. Developing appropriate land-use and management for arable and non-arable land to prevent soil erosion, increase biomass.

b. Promote income-generating activities and improve infrastructure and social services, towards improvement of livelihoods of local communities and indigenous people.

c. Strengthening the prevalent agroforestry system, and redesign as site specific requirements.

d. Redevelop the village ecosystem through introduction of appropriate energy technology interventions

e. Strengthen conservation measures based upon traditional knowledge and value system where the community can identify themselves closely.

f. Develop technical and institutional arrangements to mitigate the effects of natural disasters.

Rehabilitation package pert chart

Under preparation

Anticipated quality of produce

Under preparation

Estimated farm output from the proposed agri-horti-silvi farming system

The model package is being proposed at Dirrang block which is 45 Km away from district head quarter Bomdila under West Kameng district, Arunachal Pradesh. Monpa tribe mostly inhabits this area. The agroclimate condition of the area varies from subtropical to temperate. An agri-horti-silvi farming system is being designed to incorporate agriculture, horticulture and forestry species along with medicinal plants considering suitability of the species to the prevailing agroclimate and market potential. In the following paragraph identified crops and economics is elaborated. However, the model proposed is based on field observation and secondary data compilation.

Model farm details

Area : 5 ha

Location: Dirang Block

Altitude: 1600-1800 m msl

Agroclimate : Subtropical

Annual average rainfall: 200 mm

Annual average temperature: 0-10°C

Soil type: Red sandy to red loamy

Existing vegetation: Oak, Chir pine, Erythrina, Alnus

Cropping pattern: Paddy, maize and wheat in settled area and maize, millets, pulses, tuber crops, vegetables in Jhum land

Existing horticultural orchards: Apple, walnut, kiwi, orange

Extent of jhuming: >25%

Potential for developing agri-horti-silvi farming system

- Agricultural crops: Paddy, maize, wheat, millets, pulses
- Horticultural crops: Apple, walnut, kiwi, orange, pear, peach, plum, pomegranate
- Medicinal species: Geranium, Ginseng, Kutki
- Forestry species: Oak, Chir pine, Alnus

Table10.1 Area allocation under different farm component

Farm component		Area in ha
Agricultural crops		1.50
Horticultural component	Orange orchards	2.00
	Orchid farm	0.05
	Vegetables	0.40
Forestry species		1.00
Medicinal plants		0.05
Total area		5.00

Table 10.2Cost estimates for the farming system and its maintenance for 10 years

Sl. No	Component	Area ha	Cost(in Rs.)	Return(in Rs.)
	Agricultural farm	1.50	Under calculation	
1	Orange orchards	2.00		
2	Orchid farm	0.05		
3	Vegetable garden	0.40		
4	Ginseng	0.05		
5	Forestry species	1.00		

Table10.3 Crop season wise area allocation and expected yield under each component of the proposed agri-horti-silvi farming system.

Component	Area (Season wise) in hectare		Expected yield in ton	Estimated cost of production(Rs.)
	Kharif	Rabi		
Agriculture				
Paddy	0.5	0.5	1.1	Under calculation
Wheat		0.5	0.65	
Maize	0.5[1]		0.68	
Pulses	0.5[1]	0.25	0.76	
Millets	0.5	-	0.43	
Oilseeds		0.25	0.25	
Horticulture crops				
Orange orchards	2		800000[3]	381200
Pulses[2]	0.5	0.5	1.01	
Orchid farm	0.05		2500+2500[4]	179200
Medicinal plants	0.05		27.5+125[5]	391250
Forestry species[6]	1.0		See foot notes	

[1]Maize and pulse are used as intercrop, [2] Pulse as intercrop in orange orchard till 2nd year of plantation, [3] No of fruits of first harvest, [4] No of cut flowers and spikes at first harvest. [5] Seeds and dried roots at first harvest. [6] *Biomass generation of the species is under calculation*

Identification of possible means of funding

Rehabilitation package on the watershed approach can be facilitated by a local institution (NGOs, CBOs and Vos) through the technical support of a research Instutions (TERI) or Directorates of Agriculture & Horticulture with core support of a major Nodal supportive Agency (MOA, MOEF, MORD, International Funding from Agencies like GTZ, etc). The effort calls for an integrated approach through linkages among the line department (Soil Conservation, Rural Development, etc.) of the State, for technical and financial support on schemes for creation & strengthening of alternative livelihood support systems towards long terms sustainability. The Diversification & strengthening of livelihoods support in addition to agriculture & horticulture will be essential as agriculture & horticulture alone would not be able to address the issue of poverty & subsequent income generation towards settled agriculture.

Watershed Development Fund[1]

Realising the effectiveness of the watershed approach adopted for controlling the degradation of land and subsequent increase in productivity, the Union Finance Minister announced (1999-2000) the creation of a Watershed Development Fund (WDF), where the WDF has since been established at the National Bank for Rural

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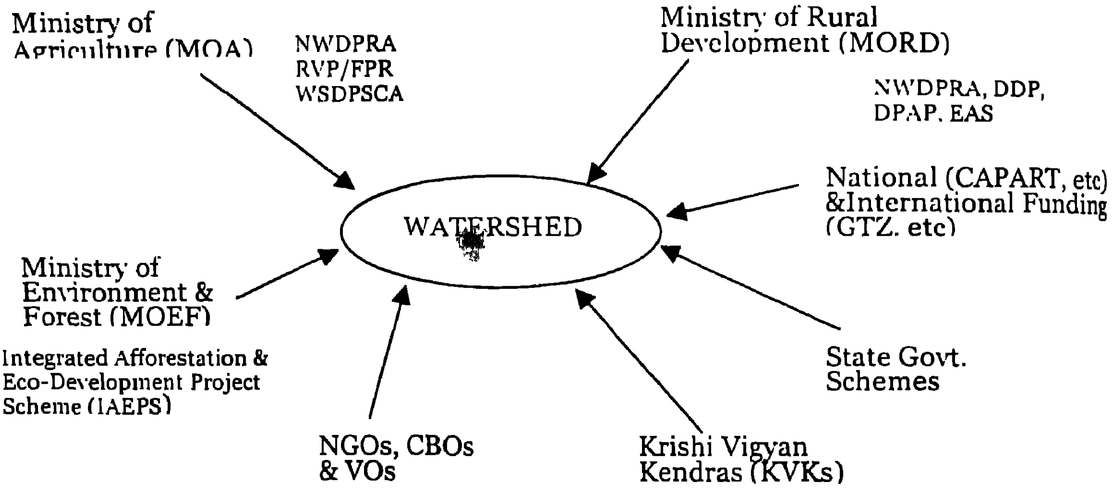
[1] New Imitative for Combating Desertification, Govt. Of India

Development (NABARD) with an objective of participatory watershed development activities, where the funds will be utilised to create the necessary framework conditions to replicate and consolidate the successful initiatives under different programmes in the government, semi-government and NGO sectors. The choice of district may be determined in consultation with the concerned State Government Departments. The districts and blocks selected should be predominantly backward, with significant proportion of the SC/ST population, having irrigation percentage preferably less than 30 percent (national average) and where the potential of watershed development is large.


Ministry of Agriculture (MOA)
NWDPRA
RVP/FPR
WSDPSCA
Ministry of Rural Development (MORD)
NWDPRA, DDP, DPAP, EAS
National (CAPART, etc) &International Funding (GTZ, etc)
WATERSHED
Ministry of Environment & Forest (MOEF)
Integrated Afforestation & Eco-Development Project Scheme (IAEPS)
State Govt. Schemes
NGOs, CBOs & VOs
Krishi Vigyan Kendras (KVKs)

Integration of projects and schemes into the watershed concept

Perspective plan for integrated Watershed Programme[1]

A 25-Year Perspective Plan has been prepared to cover an estimated area of 63 million hectare that would be treated under various watershed development projects/programmes involving an overall investment of Rs.76, 000 crore, table 10.1. These include the watershed development projects of the Central Ministries (Agriculture, Rural Development and Environment & Forests). Out of this, an area of 10 million hectare has been covered during the 9th Five Year Plan. A vision 2020 for the RVP & FPRs and the WDPSCA has been drawn to cover an area of 10 mha.

Table 10.1 Perspective vision 2025 Plan for Watershed Development of Rainfed areas

Plan	Year	Area proposed to be covered (mha)	Cost/ha (Rs in 000)	Total cost (Rs in crores)
10th	2002 - 2007	12	7 5	9, 000
11th	2007 - 2012	15	11	16, 500
12th	2012 - 2017	15	15	22, 500
13th	2017 - 2022	11 40	20	22, 800

Source: Ministry of Environment & Forest, Govt of India.

Micro credit

The concept of rural saving for micro credit development would help in mobilising rural savings and help in empowering the poor. Besides it would help in decreasing rural debt and generate income-generating activities and provide flexibility and better reach and solutions to local problems. Micro credit habits has to be initiated in order that the farmers can have the matching percentage required for availing the schemes available with the line departments. Besides its can be a supporting activity to help build associated support structure for the farming. Thus micro credit habit would be considered as the backbone for the rehabilitation programme. Funding support for the activity can be made available from banks and financial Instutions (SBI, NEDFi, SIDBI, etc.).

Schemes such as the Swarnjayanti Gram Swarozgar Yojana can be an ideal opportunity where the scheme aims at establishing a large number of micro-enterprises in the rural areas, and building upon the potential of the rural poor on a group approach. The objective under SGSY is to bring every assisted family above the poverty line in three years. SGSY has been conceived as a holistic programme of micro-enterprises covering all aspects of self-employment, viz., organization of the rural poor into Self-help groups and their capacity building, planning of activity clusters, infrastructure build up, technology, credit and marketing. The major share of SGSY assistance will be in activity clusters. Critical gaps in investments will be made under SGSY subject to a ceiling of 20% (25% in the case of North Eastern States) of the total programmes allocation for each district. SGSY is a credit-cum-subsidy programme. However, Credit will be the critical component in SGSY, subsidy being only a minor and enabling element. Subsidy under SGSY will be uniform at 30% of the project cost, subject to a maximum of Rs. 7500. In respect of SC/STs, however, these will be 50% and Rs. 10000 respectively. For Groups of swarozgaris (SHGs), the subsidy would be at 50% of the cost of the scheme, subject to a ceiling. Rs. 1.25 lakh. There will be no monetary limit on Subsidy for irrigation projects. Accordingly, the SC/STs will account for at least 50% of the Swarozgaris, women for 40% and the disabled for 3%. SGSY will be implemented by the DRDAs through the Panchayat Samithis. Central and State Governments are sharing funds under the SGSY in the ratio of 75:25.

Extension service

Development of agriculture and horticulture sector depends on selection of location specific crops, availability of quality planting materials, management practices, pre harvest and post harvest management practise, marketing network etc., along with effective transfer of technology, which has to be facilitated through the related departments and extension system and available infrastructure facilities. This would be effective if technologies are properly transferred to field level. In this context, extension system can play a vital role in disseminating the information to farm level. The support services can be availed through the infrastructure that has been developed during the 9th plan and from those being developed under the 10th plan. Areas proposing for development for agriculture and horticulture will have to interact closely with the local Agriculture, Horticulture directorates and avail the support of the extension personnel (extension officer, VLEW's), and train up village level extension workers in order to facilitate the serve within the rehabilitation area, Prospects for setting up of Agriculture, Horticulture clinic with support from SFAC can also be a viable proposition.

Agricultural extension involves offering advice, helping farmers to analyse problems and identify opportunities, sharing information, supporting group formation and facilitating collective action. It promotes agricultural development by providing the extension functionaries and the farmers with information, training and other extension support on continuous basis regarding improved production technologies. The extension system should carry the problems of the farmers to the research stations and solutions to the farmers along with establishing coordination with input agencies and credit institutions to help meet the requirements of farmers.

The principal objective of all extension education activities is to develop necessary skills and knowledge of improved agricultural technology among the extension functionaries to increase the agricultural production. Effective communication in extension is important in dissemination of information in regard to proper practice, cost effective technologies and management and planning practices to target group. The extension effort would be in two parts, viz. the training of government staff and training of cultivators/farmers and others. Extension organisation should identify its target group, the nature of extension activity and agricultural technology and work to achieve the expected result.

Extension service for Technology Transfer

The essential links between researchers and practitioners are generally provided by extension and or technology transfer mechanisms. Extension is generally associated with a classical type service where personnel specifically dedicated to extension work within a prescribed region making regular visits to growers/end users to provide advisory services. Technology transfer involves communicating results of research to appropriate end uses/stakeholders in such a way that is can be understood and evaluated for a range of conditions.

The role of extension system is to render services to the farming community and extension functionaries as well as rural mass of the area in upgrading their standard of living through sustainable agriculture as well as gainful employment. In collaboration with the Departments of Agriculture, Veterinary, Fishery, Sericulture, horticulture and other Govt. departments and in liaison with various promotional institution and organization of the Govt. of India, it is maintaining its constant effort to improve not only agrarian economy but also the economy of a state.

The extension personnel should work closely with farmers and their organizations, to understand their needs and also to study how research and extension linkages could be further strengthened and made more responsive to farmers. Their main role should be to review the existing structure of agricultural extension and research and their operations in different ecological zones, proposes options for improving farmer participation in research and extension and suggests measures to improve quality management and cost effectiveness.

In order to make the existing agricultural research and extension system more farmer participatory, the strategy should be to make extension more need based and involve farmers more actively in the generation of need based technology by adopting different approaches to suit the different agricultural situations.

Objectives

The broad objectives of extension system are:

- To provide useful information to farmers/growers to help and solve their problems based upon findings of research and technology.
- To provide advisory service to the farming community on the basis of their needs
- To conduct demonstration and training programme for the benefit of farmers and growers, farmwomen, extension workers, and others connected with agricultural/horticultural production system.
- To provide information for improving income and living conditions of the farming community apart from increase in agricultural production.
- To coordinate with other functions of the concerned departments and other appropriate agencies in promoting agricultural production system.
- The extension specialist and other extension staff of the state provide technical guidance to farmers through individual, farm and home visit, personnel contact and correspondences.

Specific task to be done for effective extension work

- Apart from crop specific training, farmers need to be trained in organic farming practices, integrated nutrient and pest management practices, in appropriate measures to increase cropping intensity, in agro-forestry in rainfed areas, post harvest handling, marketing, processing, bee keeping, mushroom cultivation.

- Trainers should be trained in PRA techniques, community mobilisation, group formation, communication methods and strategies.
- Efforts are to be made for the collection of indigenous practices that are presently following by the local communities and scientific rationale behind each of these worked out for further development of these practices.
- Situation specific technologies for income generation should be generated, field-tested and operationalized.
- Department of Agriculture/horticulture may give more emphasis on strengthening extension services and skill upgradation of farmers to adopt new technologies for profit maximization.
- Extension personnel should facilitate farmers to form Self-Help Groups for resource sharing and effective utilisation of extension services.
- Extension personnel at all levels must be trained on new extension methodologies and agricultural innovations for their skill upgradation.

Activities Taken Up In North-Eastern States for extension works:

The scheme 'Training and Extension Support to North-Eastern States" of Training Unit is in operation in all North Eastern States except Assam. The main objective of the scheme is to improve the professional competence of the extension functionaries, to strengthen the State farm information unit and research extension linkages through organizing refresher training course to Village Level Extension Workers (2 Nos./State), farmers' training (30 Nos./State) and field demonstrations (30 Nos./State), production of literatures, Audio Video Aids, Video Films.

The present extension system in the state is

Directorate of Agriculture and Horticulture at state level
↓
District agricultural/horticulture officer at district level
↓
Agriculture development officer/Extension officer
↓
Village level extension worker at block level

Role of village level extension workers is to make effective communication with the target group in order to build up confidence among them and also to transfer of technology to farm level. The grass roots level extension workers would be more effective if they concentrate their work on any one area like, agriculture, horticulture, and animal husbandry.

From our personnel discussion with the villagers it was found that the farmers are facing some sorts of problem regarding post plantation back up support from the concerned department. Therefore, it is important aspect for the extension functionary to keep close coordination with the farmers for making their system effective and also to disseminate the technology to farm level.

Development of horticulture calls for pre harvest and post harvest practise and availability of quality planting materials, which has to be facilitated locally. The support services can be availed through the infrastructure that has been developed during the 9th plan and from those being developed under the 10th plan. Areas proposing for development for agriculture and horticulture will have to interact closely with the local Agriculture, Horticulture Directorate and avail the support of the VLWs, and train up village level extension works in order to facilitate the serve within the rehabilitation area, Prospects for setting up of Agriculture, Horticulture clinic with support from SFAC can also be a viable proposition.

Post harvest technology (PHT)

Horticulture products (Fruits, vegetables, root crops, ornamentals) are living tissues and are inherently perishable in nature. These products are subject to continuous change after harvest. These changes are accelerated by several factors in transit between field and market, leading to large-scale loss. Post harvest technology is a mix of various techniques, procedures, methods and practices, which control physiological changes in produce and reduce post harvest losses.

Many of the PHT are not new. In some form they have been part of traditional crop handling methodology. However, the practices that are used in PHT today improve the techniques to a level, which maximises the returns from produce. Post harvest methods extend life and marketability of produce.

Basic objectives of PHT

- Ensure a good quality crop through improved pre-harvest and harvest methods
- Improve techniques for grading and maturity determination

- Eliminate or check harmful microorganisms through treatment of produce
- Increased care in handling produce - in fields, during transportation and at the market
- Protect perishables with appropriate packaging
- Develop effective, economical methods to control temperature and humidity during storage and transportation
- Rapid transportation and more efficient distribution system

Production systems and their influence on processing

The quality of a processed product depends on the quality of the raw material. On the other hand, the quality of the raw material also depends on the way that it is handled during the production process. Harvest and post-harvest handling also influences the quality of a product.

However, it is not only the harvest and post-harvest processes that have an impact on the quality of the raw material. The entire production process is important, from planting or sowing to harvesting. And even before sowing, the selection of the soil, planting material to be planted and of the climatic condition of the area, will undoubtedly have a significant impact on the final outcome, on the quality of the raw material, and on the processed product.

Some of the important factors in the handling of crops or natural resources:

- Utilization of cultivars or varieties suitable to the characteristics of the specific environment.
- Technical management of the levels of fertilization required for an appropriate plant growth.
- The control of the plant's water resources is a factor, which largely determines final quality.
- The management of all aspects related to plant health is crucially important in the case of a raw material that must meet minimum quality requirements to be processed, as health standards will determine final quality

Pre-harvest and post-harvest care as a quality factor

Harvest and post-harvest care is an aspect of paramount importance, as fruits and vegetables are usually rapidly perishable. Therefore, since industrial performance depends on post-harvest quality, special care must be taken in the period between harvesting of the material and the beginning of processing.

The harvesting method employed and the duration of the harvesting period will also influence the quality of the raw material. In this case, care must be taken to make sure that the harvest operation is performed properly, at the right time and in a way that will not affect the product.

The transportation of the material to the farm and its preservation, the use of containers that will not spoil the material, and transportation from the farm to the plant are factors that also influence the quality of the material to be processed. Very sensitive materials, with a high respiration rate must be processed rapidly or must be stored at relatively low temperatures

Post harvest handling steps

The most common causes of post harvest losses in developing countries include rough handling and inadequate cooling and temperature maintenance. The lack of sorting to eliminate defects before storage and the use of inadequate packaging materials further add to the problem. In general, minimizing rough handling, sorting to remove damaged and diseased produce and effective temperature management will help considerably toward maintaining a quality product and reducing storage losses. Maintaining an optimum temperature during post harcest periods will help in enhancing the storage life periods of crops.

Principal causes of post harvest losses and poor quality

Causes of Post harvest Losses and Poor Quality for Various Groups of Fruits and Vegetables

GROUP	EXAMPLES	PRINCIPAL CAUSES OF POSTHARVEST LOSSES AND POOR QUALITY
Root vegetables	Carrots	Mechanical injuries
	Onions	Sprouting and roving
	Garlic	Water loss (shriveling)
	Potato	Decay
	Sweet Potato	Chilling injury (subtropical and tropical root crops)
Leafy vegetables	Lettuce	Water loss (wining)
	Spinach	Mechanical injuries
	Cabbage	Relatively high respiration rates
Immature-fruit vegetables	Cucumbers	Decay
	Squash	Over maturity at harvest
	Eggplant	Water loss (shriveling)
	Peppers	Bruising and other mechanical injuries
	Okra	Chilling injury
	Beans	Decay
Mature-fruit vegetables and fruits	Tomato	Bruising
	Citrus	Water loss
	Bananas	Chilling injury (chilling sensitive fruits)
	Apples	Decay
	Grapes	Decay

Harvesting and preparation for market

Mechanical damage during harvest can become a serious problem, as injuries predispose produce to decay, increased water loss and increased respiratory and ethylene production rates leading to quick deterioration.

Manual harvesters should be well trained in the suitable way to harvest the crop to minimize damage and waste, and should be able to recognize the appropriate maturity stage for the produce they are handling. Exposure to the sun should be avoided as much as possible during and after harvest, as produce left out in the sun will gain heat and may become sun-burned. Night or early morning harvest is sometimes an option for harvesting produce when internal temperatures are relatively low, reducing the energy needed for subsequent cooling.

Any practice that reduces the number of times the produce is handled will help reduce losses. Field packing (selection, sorting, trimming and packaging of produce at the time of harvest) can greatly reduce the number of handling steps the produce must undergo before marketing.

Maturity standards

Maturity standards have been determined for many fruit, vegetable and floral crops. Harvesting crops at the proper maturity allows handlers to begin their work with the best possible quality produce. Produce harvested too early may lack flavor and may not ripen properly, while produce harvested too late may be fibrous or overripe. Pickers can be trained in methods of identifying produce that is ready for harvest. Vegetables are harvested over a wide range of maturities, depending upon the part of the plant used as food.

Table 10. 2: Signs of physiological maturity of some agricultural produce

Crop	Signs for maturity	Moisture content
Maize	Cob almost dry, husks yellow, grains hard and vitreous, black spot at the base of the grains	23 28%
Sorghum	Stem and leaves dry, grains hard and relatively vitreous (depending on variety)	20 25%
Rice	Panicle benching down, husks yellow, grains complete, neither green nor shrivelled	22-28%
Beans	Pods ripe and yellow, but still closed	30-40%

The indicated moisture content at the time of maturity does not mean that the crop is fit for storage.

Table 10. 3. Maturity Indices for some Commercial Cultivars of Apple

Cultivars	Days from full bloom	Firmness (kg)	TSS (%)
Royal Delicious	125 ± 5	8.2 ± 0.40	13.0 - 15.0
Red Gold	122 ± 3	8.3 ± 0.20	12.0 - 13.5
Red Delicious	134 ± 5	8.4 ± 0.40	10.0 - 14.0
Golden Delicious	148 ± 6	8.4 ± 0.40	12.0 - 14.5
Granny Smith	180 ± 5	8.7 ± 0.30	11.5 - 13.0

Preventive measures to be taken before harvesting

The following methods contribute to preventing pest infestation from the field into the stores:

- Crop rotation and mixed cropping
- Selection of less susceptible cereal varieties (e.g. maize with hard seed coat and husks covering the cob completely)
- Choice of the time of harvesting
- Watch out for the signs of physiological maturity.

Harvesting practices

Harvesting practices should lead to little mechanical damage to produce as possible. Gentle digging, picking and handling will help reduce crop losses.

Field curing

Yams and other tropical root and tuber crops can be cured outdoors if piled in a partially shaded area. Cut grasses or straw can be used as insulating materials and the pile should be covered with canvas, woven grass mats and the stack should be left for about four days. Curing requires high temperature and high relative humidity, and this covering will trap self-generated heat and moisture.

Onions and garlic can be cured in the field in regions where harvest coincides with the dry season. The produce can be left in the field for five days, then checked daily until the outer skin and neck tissues are properly dried. Curing may take up to ten days, depending on weather conditions.

Curing with heated air

The most uniform distribution of heat is obtained when heat is introduced near the floor level of a curing structure. Heaters can be placed on the floor near the bins of produce, or heat can be ducted in from outside the curing room. A high relative humidity can be obtained by wetting the floor or by using an evaporative cooler in the room without introducing outside air.

Packinghouse operations

Packinghouse operations can be as simple as moving produce from a field into a shipping container, or may include a variety of handling practices, from cleaning, waxing, sizing, and quality grading to color sorting. The provision of shade during the packing operations is extremely important. Shade can be created using palm leaf fronds; thatch, a plastic mesh or canvas sheet hung from temporary poles, or via a permanent roofed structure.

In the simplest packinghouse, produce is delivered in picking containers, immediately after harvest, directly to the packers. The packers then sort, grade, size and pack the produce directly into appropriate transport containers. In this case, each worker must be knowledgeable regarding produce defects, grade and size requirements, and packing methods.

Pre-sorting

Pre-sorting produce is usually done to eliminate injured, decayed, or defective produce before cooling or additional handling. Pre-sorting will save energy in that produce will not be handled. Removing decaying produce items will limit the spread of infection to other units, especially if post harvest pesticides are not being used.

Cleaning

Fruits, such as kiwifruits and avocadoes, dry brushing may require sufficient cleaning the produce. Other commodities, however, such as bananas and carrots, require washing. The choice of brushing and/or washing will depend upon both the type of commodity and the type of contamination.

Sizing

In most low-input packinghouses, manual sizing is still commonly practiced. Operators should be trained in selecting the size desired and to either directly pack the items into containers or place the selected produce gently into a bin for packing further down the line.

Dumping

Any time produce is dumped from one container into another, care should be taken to reduce mechanical damage to the commodity. When dumping produce from field bins or from transport vehicles into the packinghouse, dry or wet dumping can be practiced. When using dry dumping practices, the filed container should be emptied slowly and gently.

Washing

Steel drums can be used to make a simple washing stand. The drums are cut in halt fitted with drain holes and all the metal edges are covered with split rubber or plastic hose. The drums are then set into a sloped wooden table.

Packing and packaging materials

If produce is packed for ease of handling, heavily waxed cartons, wooden crates or rigid plastic containers are preferable to bags or open baskets, since bags and baskets provide no protection to the produce when stacked. Sometimes locally constructed containers can be strengthened or lined to provide added protection to produce. Waxed cartons, wooden crates and plastic containers, while more expensive, are reusable and can stand up to the high relative humidity found in the storage environment. Containers should not be filled either too loosely or too tightly for best results. Packing materials can act as vapor barriers and can help maintain higher relative humidities within the package. In addition to protection, packaging allows quick handling throughout distribution and marketing and can minimize impacts of rough handling.

Labelling

Labelling packages helps handlers to keep track of the produce as it moves through the post harvest system, and assists wholesalers and retailers in using proper practices. Labels can be preprinted on fiberboard boxes, or glued, stamped or stenciled on to containers. Brand labeling packages can aid in advertising for the product's producer, packer and/or shippers. Some shippers also provide brochures detailing storage methods or recipes for consumers.

emperature and relative humidity control

Throughout the period between harvest and consumption, temperature control has been found to be the most important factor in maintaining product quality. Fruits, vegetables and cut flowers are living, respiring tissues separated from the parent plant. Keeping products at their lowest safe temperature (0° C for temperate crops or 10-12° C for chilling sensitive crops) will increase storage life by lowering respiration rate, decreasing sensitivity to ethylene and reducing water loss. Reducing the rate of water loss slows the rate of shriveling and wilting, causes of serious post harvest losses. It is important to avoid chilling injury, since symptoms include failure to ripen (bananas and tomatoes), development of pits or sunken areas (oranges, melons and cucumbers), brown discoloration (avocados, cherimoyas, eggplant), increased susceptibility to decay (cucumbers and beans), and development of off-flavors (tomatoes) (Shewfelt, 1990).

Several simple practices are useful for cooling and enhancing storage system efficiency wherever they are used, and especially in developing countries, where energy savings may be critical. Shade should be provided over harvested produce, packing areas, for buildings used for cooling and storage and for transport vehicles. Using shade wherever possible will help to reduce the temperatures of incoming produce.

Another aspect to consider when handling fruits and vegetables is the relative humidity of the storage environment. Loss of water from produce is often associated with a loss of quality, as visual changes such as wilting or shriveling and textural changes can take place

Room cooling

Room cooling is a relatively low cost but slow method of cooling when electricity for mechanical refrigeration is available. The greater the refrigerator's evaporator coil area, the less moisture will be lost from the product as it cools.

It is important to leave adequate space between the stacks of boxes inside the refrigerated room in order for produce to cool more quickly. Air circulating through the room passes over surfaces and through any open space, so cooling from the outside to the center of the stacks is mostly by conduction.

Forced-air cooling

Forced-air cooling pulls or pushes air through the storage containers themselves, greatly speeding the cooling rate of any type of produce. Many types of forced-air coolers can be designed to move cold moist air over the commodities.

Evaporative cooling

For evaporative cooling the packinghouses are made from natural materials that can be moistened with water. Wetting the walls and roof first thing in the morning creates conditions for evaporative cooling of a packinghouse that is made from straw. An evaporative cooler can be combined with a forced air cooler for small lots of produce. Air is cooled by passing through the wet pad before it passes through the packages and around the produce.

Night air ventilation

Storage structures can be cooled using night air if the difference in day and night temperature is relatively large. The storage facility should be well insulated and vents should be located at ground level. Vents can be opened at night, and fans can be used to pull cool air through the storeroom The structure will best maintain cool temperatures during the heat of the day if it is well insulated and vents are closed early in the morning.

Chilling injury

Fruit and vegetable crops often are susceptible to chilling injury when cooled below 13 to 16^0 C cilling injury reduces the quality of the product and shortens shelf life.

Table 10.4 Fruits and vegetables susceptible to chilling injury under low nonfreezing temperatures

Commodity	Approximate lowest safe temperature °C	Character of injury when stored between 0°C and safe temperature[1]
Apples-certain cultivars	22-3 0^0 C	Internal browning, brown core, soggy breakdown, soft scald
Bananas, green or ripe	11.5-13.0	Dull color when ripened
Beans (lima)	1.0-4.5	Rusty brown specks, spots, or areas
Beans (snap)	7.0	Pitting and russeting
Cucumbers	7.0	Pitting, water-soaked spots, decay
Eggplants	7.0	Surface scald, alternaria rot, blackening of seeds
Guavas	4.5	Pulp injury, decay
Grapefruit	210	Scald, pitting, watery breakdown
Lemons	11.0-13.0	Pitting, membranous staining, red blotch
Limes	7.0-9.0	Pitting, turning tan with time
Okra	7.0	Discoloration, water-soaked areas, pitting, decay
Olives, fresh	7.0	Internal browning
Oranges	3.0	Pitting, brown stain
Papayas	7 0	Pitting, failure to ripen, off flavor, decay
Peppers, sweet	7.0	Sheet pitting, alternaria rot on pods and calyxes, darkening of seed
Pineapples	7.0-10.0	Dull green when ripened
Pomegranates	4.5	Pitting, external and internal browning
Potatoes	3.0	Mahogany browning (Chippewa and Sebago), sweetening.
Pumpkins and hard shell squashes	10.0	Decay, especially alternaria rot
Sweet potatoes	13.0	Decay, pitting, internal discoloration, hardcore when cooked
Tomatoes Ripe	7.0-10.0	Water soaking and softening, decay
Mature green	13.0	Poor color when ripe, alternaria rot

The fundamentals of storage

Properties of stored produce

The most commonly stored forms of food (cereals and legumes) are living seeds. They contain a high concentration of nutrients and are easily storable due to their low moisture content.

Respiration

A grain is a living organism that breathes. During respiration, starch and oxygen are converted to carbon dioxide as well as water and heat. An increase in the storage temperature leads to an increase in the respiration rate. Nutrients being respired lead to losses in the weight and quality of stored produce.

Moisture content

Grains contain water. The moisture content of stored produce is fluctuating. A moisture content above a certain safe limit that depends on the type of grain is conducive to infestation with fungi and insects and makes the produce more rapidly perishable.

Heat Conductivity

Cereals and legumes have low heat conductivity. This means that local fluctuations in temperature in the stored produce are only noticeable over short distances or long periods. This leads to the accumulation of heat with all of the accompanying disadvantages, such as increased respiration, higher insect infestation and condensation.

Effect of Temperature

The temperature has a great influence on the respiration rate of the stored produce and pest organisms as well as on the relative humidity and the grain moisture content. The temperatures to be found in tropical and subtropical climates provide ideal living conditions for insect pests and in high relative humidity places, also for fungi.

Safe Moisture Content of Stored Produce for Long-term Storage

When the stored produce is moist, there is a danger of fungi and mould development. Fungi start growing at a relative humidity of above 65-70%. The safe moisture contents for foodstuffs for long-term storage are therefore those, which provide equilibrium at a relative humidity of 65-70%.

Post-harvest losses: Causes, Effects and Countermeasures

Post-harvest losses may occur in the following areas

- During harvesting
- During transportation
- During drying
- During threshing
- During processing
- During storage

Quantative and qualitative post harvest losses

Losses in quantity	Losses in quality (*Losses in occur in various forms*)
Losses in quantity of the stored produce result from grain being spilt or running out from damaged bags, from theft or from the grain being damaged by pest organisms. Losses in weight may also result from changes in the grain moisture content during the storage period.	• Changes in colour • Changes in smell & taste • Loss in nutritional value (degradation of proteins and vitamins) • Loss in cooking, milling or baking quality • Contamination of stored produce with mycotoxins or pathogenic agents • Loss of germination power in seeds

Sources, causes, effect and countermeasures of post harvest losses

Sources of losses	Causes	Effect	Countermeasure
Mechanical Damage	• Incorrect harvesting methods • Poor handling, threshing, shelling, cleaning, sorting or drying • Bad transport and loading practices.	• Losses in weight • Losses in quality (germination power, nutritional value) • Increased vulnerability to infestation from insect pests, fungi and rodents	• Pay attention to maximum temperatures when drying • Use safe techniques in harvesting, transport, processing and storage and handling. • Repair or replace damaged bags
Heat	• Unsuitable storage structures (false location, insufficient shade and ventilation facilities, lack of heat insulation) •Mass reproduction of storage pests and fungi • Lack of aeration of storehouse. • High moisture content of the grain.	• Losses in weight • Losses in quality (nutritional value, germination power) • Good conditions for pest development • Condensation with subsequent development of fungi	• Build suitable storage structures • Provide shade for stores. • Keep temperatures as low as possible. • Conduct treatments for pest control • Store bags on pallets in order to improve aeration.

Farm and village level storage

Farm storage methods

Farmers traditionally store their grain in an unthreshed state. This is first because they often do not have the time to thresh the grain after harvesting, and secondly because they rely on the lower susceptibility of grain stored in husks to infestation from pests. The storage period on farm level generally lasts 6 to 12 months.

After harvesting, the grain is kept in a variety of different traditional storage containers which are in general perfectly adapted to the existing social, economic and climatic conditions and require only locally available materials. Three basic forms of small farm storage can be distinguished: open, semi open and closed storage systems.

Open Storage Systems

In unfavourable hot and humid climatic conditions almost only open storage systems are used because the stored produce is still moist when it is put into storage. Platforms resting on wooden stakes are very widespread, on which cobs or panicles are stacked in layers. A straw roof affords protection against the rain. Crops are also occasionally to be found hung up in frames or under the roof of houses. In the latter case, the fire underneath is used to dry them and to repel insects.

Semi-Open Storage Systems

This system includes containers made of woven twigs or straw as well as wooden frames with a straw mat on which the commodities are placed. Crops are generally stored in an unthreshed state, i.e. in cobs or panicles. Contact to the ground is prevented by means of stone foundations so that ground moisture cannot penetrate into the store. A straw roof affords protection against the rain.

Closed Storage Systems

For the storage of sorghum, millet, pulses, paddy and peanuts, structures are made primarily of closed storage containers made of mud, often mixed with chopped straw. The crops are generally stored in a threshed state. Problems with moisture or condensation are virtually unknown due to the low moisture content of the stored produce and the excellent insulation capacity of the mud used.

Small farm-storage in underground pits is a special form of a closed storage system of storing grain. There are no doubts as to the advantages of such a largely airtight and cool form of storage not affected by any fluctuations in temperature.

If the pit is kept satisfactorily air and watertight the development of insects and mites as well as the growth of moulds can be reduced to a minimum. A suitable site must be chosen with the right type of soil.

Drying

Sun Drying

Products must be dried to the safe moisture content before storage. The produce is placed on the ground, on platforms or on special drying racks. When drying in the sun directly on the ground, the produce must be protected from absorbing any soil moisture by using sheets or mats. The produce must be turned over regularly in order to dry it evenly. In the evening, the produce must be put in a pile and covered.

Table 10. 5 Storage condition & storage period of some agricultural and horticultural crops

Species	Pre-cooling	Storage condition		Storage period
		Temperature °C	Relative humidity	
Apple	Forced air	1°C-0°C	90-95%	2-8 months
Banana	Forced air	Holding Room 13°-14°C Ripening Room 14°-20°C	90-95%	Mature-green bananas -upto 3 weeks in ethylene free air or up to 6 weeks in a controlled atmosphere at 14°C
Lime/Lemon	Forced air	9-10°C	85-90%	6-8 weeks
Mosambi	Forced air	3-4°C to 0°C	85-90%	2-4 weeks
Orange	Forced air	5-7°C	85-90%	4-8 weeks
Grapes	Forced air	-5 to 0°C	85-90%	3-8 weeks
Papaya	Forced air	10-13°C	85-90%	1-3 weeks
Brinjal	Forced air	8-12°C	90-90%	1-2weeks
Cabbage	Pre-cooling	0°C	98-100%	3-6 weeks
Okra	Pre-cooling	7-10°C	90-95%	7-10 days
Onion	-	0°C	90-95%	3-5 months
Peas	-	0°C	98-100%	3-7 days
Potato	-	3-4°C	90-95%	5-10 months
Tomato	-	10°C-13°C	85-90%	7-10 days

Post harvest technology for some agricultural and horticultural crops

Grapes

Harvested grapes are packed in 2 to 4 kg corrugated boxes. Pre cooling and use grape guards are must for cold storage and export market. Under cold storage condition duration of storage can be increased to 40-45 days.

Apple

After harvesting fruits are sorted out and healthy fruits are cleaned by wiping or washing to remove dust and dirt. Apple fruits are graded according to size and shape, colour and permissible skin blemishes.

Banana

The fruits can be stored at a temperature of 13°C and a relative humidity of 85 to 95 per cent for about three weeks. At low temperatures, the banana fruits become black and therefore they should not be placed in refrigerator. Ripening of banana fruits can easily be retarded for 10-12 days at ambient temperature (about 30° C) held in sealed polythene bags. Mature green banana fruits after harvesting resulted in reducing ripening without affecting fruit quality when they are immerged in hot water at 50° C for 15 min or 54° C for 10 min.

Mosambi

After harvesting fruits are spread in shade, undesirable fruits (injured, malformed, immature, over mature etc.) are sorted out from the whole lot. Fruits are packed in bamboo basket and wooded boxes. Paddy straw and any kind of soft dry grass are excellent for padding around the fruits inside the package.

Mandarin

After harvesting fruits unwanted fruits are spread sorted out. Fruits are packed in bamboo basket and wooded boxes. The fruits are wrapped with paper individually before arranging in containers. The storage life can be prolonged under cold storage at 35-40° F with 80-95 per cent relative humidity.

Lemon

The storage life of lemon is increased at temperature of about 13 to 14° C and 88 per cent relative humidity; the use of wax emulsion is further beneficial.

Guava

Half mature fruits are good for sending to distant markets. The fruits are packed in wooden crates or bamboo basket. Storage life can be prolonged for 20-25 days at 10° C

Papaya

Fruits are wrapped in newspapers and packed in a single layer in bamboo baskets putting lining material with paddy straw or sawdust. Fruits can be stored at 20° C.

Pomegranate

Healthy fruits are packed in bamboo baskets and wooden crates containing 10-12 kg or so fruits with a padding of paddy straw or dry grasses. Pomegranate fruits can also be stored for about 5-6 months or so at 4.5° C at 80-85 per cent relative humidity.

Litchi

The fruits are kept in cool, dry and well-ventilated places. Fruits should not be exposed to sun. The fruits are graded and packed in shallow baskets or crates lined with litchi leaves or soft dry grasses or banana leaves or newspaper. Fruit can be stored for a couple of weeks at 2.2 to 3.3° C temperatures and 80 to 85 per cent relative humidity.

Pineapple

Injured fruits are sorted out. Crown as well as fruit stalks are trimmed to desired level. Fruits are conveniently packed in light wooden crates. Healthy fruits can be stored well for 10-20 days under ordinary conditions. For about 5-6 weeks or so mature and ripe fruits can be stored at 11-13° C and 8-9° C at 85-90 per cent relative humidity respectively.

Cardamom

After harvest, capsules are dried at 45-50° C for 14 to 18 hours. The capsules kept for drying are spread thinly and stirred frequently to ensure uniform drying. The dried capsules are rubbed with hands or coir mat or wire mesh and winnowed to remove any foreign matter. They are then sorted out according to size and colour, during storage. These bags are then kept in wooden chamber. After harvesting, the produce is dried either in the sun or in the specially built drying houses by using radiated heat. For the latter, the devices vary from sheltered mud platforms heated by a slow fire from beneath to large drying-houses to kilns heated by fuel pipes, as is mostly done in large plantations. The fruits kept for drying are spread out thinly and stirred frequently to ensure uniform drying. Sun drying takes 3-5 days, whereas in the case of artificial heating, it takes only about 48 hours for proper drying. The latter process also helps to retain the green colour of the capsule, which is much valued. The dried capsules are rubbed by hand or with rough coir matting or with a piece of wire-mesh and winnowed to remove other plant residues and foreign matter. They are then sorted according to their size and colour. Since green capsules fetch a premium price in foreign markets, it is essential to retain this colour as far as possible. For this purpose, various methods have been tried. Soaking the capsules of freshly harvested green cardamom in two per cent washing-soda solution for 10 minutes before drying to less than ten per cent moisture level and storing in gunny bags lined with two layers of polythene helps to preserve green colour effectively for 6-9 months. Similarly, bleached cardamom constitutes a distinct trade quality. Bleaching is done by exposing the dried capsules to the action of sulphur dioxide produced by burning sulphur.

Black pepper

Berries are separated from the spikes by rubbing them between the hands or trampling them under the feet. After the separation, the berries are dried in the sun for 7 to 10 days until the outer skin becomes black and shrunken and assumes the characteristics wrinkled appearance of commercial black pepper. For making good quality black pepper of uniform colour, the separated berries are collected in a perforated bamboo basket or vessel and then the basket with the berries is dipped in boiling water for one minute. The basket is then taken out and drained. The treated berries are sun dried on a clean bamboo mat or cement floor.

White pepper is prepared from fully ripened berries by removing the outer rind and the pulp before drying. The recovery of the white pepper is 25 per cent of the ripe berries whereas that of black pepper is 33 per cent.

Ginger

For preparing dry ginger the produce is kept soaked in water overnight. Rhizomes are then rubbed well to clean them. After cleaning, rhizomes are removed from the water and the outer skin is removed with a bamboo splinter or wooden knife having pointed ends. In order to get rid of the last bit of the skin or dirt, the dry rhizomes are rubbed together. The peeled rhizomes are washed and dried in the sun uniformly for one week. Rhizomes are to be dried to a moisture level of 11% and they are stored properly to avoid infestation by storage pests. Storage of dry ginger for longer periods is not desirable.

Turmeric

Harvested rhizomes are cleaned of mud and other extraneous matter adhering to them. Fingers are separated from mother rhizomes. Mother rhizomes are usually kept as seed material. The fresh turmeric is cured for obtaining dry turmeric. Curing involves boiling of rhizomes in fresh water and the drying in the sun.

No chemical should be used for processing. The cleaned rhizomes are boiled in copper or galvanized iron or earthen vessels, with water just enough to soak them. Boil till the fingers/mother rhizomes become soft. The cooked turmeric is taken out of the pan by lifting the troughs and draining the water into pan itself. The same hot water in the pan can be used for boiling next set of raw turmeric, which is already filled in troughs. The cooking of turmeric is to be done within 2-3 days after harvest. Rhizomes may also be cooked using baskets with perforated bottom and sides. The mother rhizomes and the fingers are cured separately.

The cooked fingers/mother rhizomes are dried in the sun by spreading in 5-7 cm thick layers on bamboo mats or cement floor. A thinner layer is not desirable as the colour of the dried product may be adversely affected. During nighttime the material should be heaped or covered. It may take 10-15 days for the rhizomes to become completely dry. Artificial drying using cross-flow hot air at a maximum temperature of 60°C is also found to give satisfactory product. In the case of sliced turmeric, artificial drying has clear advantages in giving brighter coloured product than sun drying which tends to suffer due to surface bleaching.

Dried turmeric has a poor appearance and rough dull colour outside the surface with scales and root bits. Smoothening and polishing the outer surface by manual or mechanical rubbing improve the appearance.

The colour of the turmeric always attracts the buyers. In order to impart attractive yellow colour, turmeric suspension in water is added to the polishing drum in the last 10 minutes. When the rhizomes are uniformly coated with suspension they may be dried in the sun.

Rhizomes for seed purpose are generally stored after heaping under shade of tree or in well ventilated shade and covered with turmeric leaves. Sometimes the heap is plastered with earth mixed with cow dung. The seed rhizomes can also be stored in pits with sawdust. The pits can be covered with wooden planks with one or two holes for aeration.

Chilies

Soon after the harvest, the produce is to heaped or kept in clean gunnies for one day for uniform colour development for the pods. Sun drying is the common practice. The preparation of drying floor differs from tract to tract. Leveled and compacted floor is to be made for drying. Fruits are spread on drying yards in layers. From the fifth day onwards, the produce is inverted on alternate days so that the pods in the lower layers are brought up to ensure quick and uniform drying. To avoid microbial activity and aflatoxin production, moisture in the dried pods should be brought down to 10%.

Since the produce is exposed to sun for 10-15 days on the open yards, it is likely to get contaminated with foreign matter. This also results in poor colour for the product due to bleaching effect of the sunrays. The produce can be dried within a period of 18 hours using air blown drier keeping temperature at 44-46^{0}C. This method saves time, avoids the drying operations for 10-15 days but also imparts deep red colour and glossy texture to the fruits. Solar drier and tray drier can be used. While drying, the produce can be covered with polythene sheets during nighttime to avoid dew deposition and resultant colour fading.

Grading is to be done to remove defective and discoloured pods. Packing is done in gunny bags, or jute boras. Chillies should be properly stored to avoid infestation of pests. It is preferable to store dried chilli in refrigerated condition (cold storage) to retain colour.

Cabbage

After harvesting the outer mature unfolded leaves are removed, and if any long hard portion of stem is present may also be removed. Heads are graded according to the size and quality and packed in gunny bags or plastic crates or bamboo basket.

The Low Cost Post Harvest Technology

Post harvest technologies should be such that which a poor farmer can afford and understand the techniques and that the end products are accepted by the consumers.

Small scale low cost PHT are important at local level along with some large scale PHT at centralized place, because for large PHT one need uniform quality of raw material throughout the year and the market for final product. Moreover, many farmers are cultivating varieties of crops as per their requirement and localities in their small farms.

When India is welcoming foreign companies to come here and start industries and take advantage of large Indian market, we should think in the direction of post harvest management and processing for better product and return from the quality produce.

Some technologies suitable for small farmers:

1. Solar Dryers: Drying is the cheapest mode of preservation of fruits, vegetables and other items. Solar drying is practiced since times in memorable.
2. Zero Energy Cold Storage: Many farmers cultivate fruits and vegetables, which are seasonal in nature. Produce of all the farmers come to the market at one go. As a result prices fall. There is a good technology called Zero energy cold storage, which could be utilized for preserving such item for few days. Zero energy cold storage is a low cost storage structure made up of sand and brick which are locally available. Everybody knows water becomes cool in an earthen pot. The water oozing out of the pot gets evaporated. While this evaporation occurs, water inside the pot becomes cold this principle is called as evaporate cooling. This principle is used for zero energy cold storage. Its a double walled room where sand is kept between the outer and inner wall. Keep the sand wet by watering. Thus the produce kept inside the inner room will be preserved longer.
3. Pickles: Pickling is one of the cheapest process of preservation of fruits and vegetables. Common salt and spices are used in conventional pickles. The process of pickling does not need energy. The process is so efficient that many people make pickles in their houses, which last even two to three years and that too without any chemical preservatives.
4. Preservations in Salt solutions: Keeping them in salt solutions can preserve Vegetables. This process can be used to prolong the shelf life of various vegetables like cabbage, okra, spinach etc. In this process vegetables are kept in salt solutions and bottled. While using, just wash the vegetables in Water to remove salt solutions. Shelf life will vary according to various factors but you can prolong shelf life at least by one month in this process.

Farmers can find many such opportunities studying food items and can prepare food items, which are plenty in one season and can be used throughout the year.

Infrastructure

Pre harvest practices can enhance the quality of crops and the market quality of produce can only be determined during the selection of the crops, the cultivars and the production system by the grower. Therefore it is important that choice of cultivars that have quality attributes, healthy high quality planting material, planting numerous cultivars of the same commodity extending harvest, cultivars suited to specific climate, photoperiod, soil and water availability conditions would be of utmost importance. Planning the *harvest dates* with local climate variations and keeping the equipments ready would be an added advantage.

Irrigation:

Essential soil moisture can be controlled through dewatering the soil in high rainfall areas or can be increased through irrigation methods that spray water on foliage or through drip techniques. Management practice in specific zones will depend upon the crop plan, as excess water or irrigation can contribute to loss of flavour, increase susceptibility to bruising and decay in storage. Besides lack of irrigation can cause low juice content and thick skin in fruits and nutrients become restricted or unavailable, in very wet or very dry soils for obvious physical reasons such as a lack of root absorption by most crop species.

Soil fertility and use of fertilisers:

Plant nutrients, divided into macronutrients and micronutrients are indistinguishable and may be from organic or chemical sources and must be water-soluble in order to enter plant root systems. Macronutrients are nitrogen (N), phosphate (P), potash (K), sulphur (S), calcium (Ca) and magnesium (Mg). Micronutrients are needed in very small quantities and are as essential as macronutrients to normal plant growth. Plant essential micronutrients are boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn) and if deficient they are applied to soil in pounds per acre. Soil fertility/ enrichment of nitrogen fertilisers in the soil can lead to infection, poor fruit development, loss of flavour in fruits. Lack of potash cans lead to poor fruit development and abnormal ripening, calcium moisture imbalance can cause blossom-end rot in tomatoes and bitter pit in apples. Likewise disbalance for soil nutrients would affect other crops.

Cultivation practise

a. Water management: Plants suffering from either a lack of or excess of water will be less vigorous and more susceptible to disease. Thus, watering should be done to wet the entire root zone. Use of drip irrigation is beneficial as it keep the foliage dry; which will reduce some foliar diseases and conserve water.

b. Pruning and thinning to improve sun penetration and ventilation is important. Fruit colour develops evenly, fruit size and quality increases, but yield decreases slightly. Encouraging plants to grow upward on trellises also lowers relative humidity and reduces incidence of disease.

c. Weed control - weeds are commonly alternate or alternative hosts for crop diseases and pests. Weeds also compete with crops for nutrients and soil moisture.

d. Crop hygiene - decaying plant residues, dead wood and decaying or mummified fruit are all reservoirs of infection causing post-harvest decay. Their collection and removal are important to keep your crop safe from bacterial and fungal damage.

e. Use cultivation practices that are appropriate for the region and climate.

Area for model rehabilitation package

The three micro catchment identified in West Kameng District for a potential rehabilitation package are, the Warzong microcatchment, Monzong microcatchment and finally the Dirang watershed.

Warzong micro watershed

Warzong microcatchment inhabited by the Mompa community is the nearest approachable watershed from Bomdila, The villages that would fall within the micro watershed are Warzong, Bizong, Thinghe and . Major agricultural activities in these villages have come under sedentary practice.

Monzong micro watershed

Monzong micro catchment, inhabited by the Mompa community next to Warzong, facilitates the villages namely Rahung, Darbu, Thingba and Samse respectively. Major agricultural activities in these villages have come under Jhum and sedentary practice.

Dirang watershed

Dirang watershed, adjoining Dirang Circle facilitates Jhum and sedentary practice and villages which could be considered under the process would include Liss, Liss Gompache, Liss Gompalok, Khamruk, Dirme, Broksathung, Yewang , Ramacamp and Dirang. A socio-economic status for the villages is presented in table 10.6. A substantial area under Jhum was noticed for villages namely Liss Gompache, Liss Gompalok, Khamruk, Dirme and Broksathung with 160 households of the Mompa community.

Table 10.6 : Socio-economic inferences for the cluster at Dirang

Village	HH	Population	Male	Female	Literacy	
					Male	Female
Dirang	183	2494	1294	1200	323	178
Liss	168	723	370	353	40	09
Liss Gompache	86	355	189	166	30	02
Liss Gompalok	20	87	40	47	07	02
Khamruk	19	25	17	8	01	0
Dirme	16	90	51	39	0	01
Broksathung	19	133	76	57	15	02
Yewang	105	1123	573	550	220	227
Rama Camp	74	663	354	309	132	79

Source: Office of the Extra assistant Commissioner, Dirang Circle.

Natural hazards in the form of flash floods have been occurring in repeated intervals in this area. Beside the proposed area is located within the periphery of epicentres of 7 to < 7.5 and 5 to < 6 in the Richter scale. Flash floods have occurred in Rama Camp, leading to washing out of houses and property, and the recent occurrence of flash flood has been at Saper Camp, which is located at a distance of 5 km away from Rama Camp, where the devastation has been in similar scales to that of Rama Camp. An important observation is that most of the villages like Liss Gompache, Liss Gompalok, Khamruk, Dirme and Broksathung are located in the higher catchment of the watershed which drains out into the river Khowna at Saper Camp and Rama Camp respectively. Under the said circumstances the area selected for the rehabilitation package would be an ideal representative sample for addressing the issues of Jhum and natural hazard for the state of Arunachal Pradesh.

land allocation and security of tenure for Jhum farmers and local communities

An important aspect for communities participation in the Project relates to land allocation and security of tenure for local communities and households. This is important from the viewpoint of the beneficiaries and for the sustainability of the Project activities. Arunachal Pradesh being a predominantly a tribal state, with no land legalisation and the only legal framework for determining the rights to cultivate land is the Jhum Land Regulations of 1947, where the rights of tribes associated with Jhum cultivation on the area operated has been accepted leaves less areas of conflict with the Forest Department. Land ownership and individual rights to use are determined by tradition and customs of the local communities and agricultural land being the village or community land, clan land and individual land. It is important to draw inferences on the ownership of the area under Jhum. Discussions held with the village community (Jhum cultivators) at the villages, and it was inferred that land under Jhum was mostly under the ownership of the clan. People continuing the age-old practice of Jhum cultivation for sustenance are the poorest of the poor in the clan. Farmers continuing the practise of Jhum usually have inherited the land from their forefathers, and those who are landless seek the Jhum land on lease form the owner on plea through an offering of chicken and local wine, with no legal agreement or share in the produce, a custom applicable under the customary law.

Discussion were also held with the local leaders (Goan Bura and MLA) and village elders, officials at the Range forest office no restriction on the part of forest department in the utilisation of land under forest cover by the villagers for converting the Jhun fallow into a settle agriculture at Dirang Circle. The declaration made by those disused is that the clan would have a major role to play in allotting the land for the rehabilitation package and Forest Department would have a limited role to play in the utilization of clan lands. However the Forest law would prevail for areas declared Reserve Forest.

Beneficiary participation and community mobilization

During primary field survey and interaction with the Jhum farmers, it was found that the ethnic minority communities are aware of declining yields from shifting cultivation, the laborious nature of the farming practice, and difficulty in maintaining the farm fields from predators and hence are preferring to adopt new ways provided they are given improved access to fencing, planting material, land and water management and technical inputs in horticulture and agriculture farming system, post plantation technical back-up, inputs, storage and post harvest management.

In this socio economic context, the Project implementation would adopt participatory approaches for local level planning from the village upwards, of land use, taking into account local land and forest resources, poverty and development levels, land and forest use patterns in terms of cultivation, dependence upon forest resources, development of cash cropping, market orientation, and livelihood needs, gender and cultural specificities.

The bulk of Project funds would be planned for activities at the local level, undertaken by communes and villages. These include land allocation, investments in poor natural forests to be rehabilitated, plantations and agro forestry. Training of participating communities will be facilitated through awareness campaigns, and village level PRAs to be carried out by multidisciplinary teams from the community and the district. Community development funds will be created through beneficiary repayments of credit for income generating activities, to be used for locally planned activities and infrastructure. This will increase the sustainability of Project investments beyond the Project period

Mobilisation of community and awareness building

Prior to the commencement of the watershed development activity, sufficient attention and time has to be devoted to generating awareness among the community members on the concept of watershed conservation and development. This would be achieved through organising repeated meetings in the respective villages and in the hamlets.

Participatory consultative process

Active participation of the stakeholders is vital for success and sustainability and this could be brought about through an active participation of the communities through involvement in the various stages of the project. Active Community participation in planning, implementation, monitoring and evaluation and finally post project management stages would help in building up a sustainable model. Initially numerous village level meetings would be held for awareness generation about watershed conservation and development, the aims of the proposed project. Thereafter meetings would be held for the formation of the individual village level watershed committees. Several group meetings would be necessary for undertaking the different exercises under PRA. The individual village level action plans would be finalised through a consultative process, where village representatives (committee) guided the active participation of the village community.

11

Assessment of Infrasctucture gaps and potentials

Availability of infrastructure facilities in particular state is a pre-requisite for development and it plays a vital role and has a direct effect on the overall development of an area. Better infrastructure such as, road, railways, aviation, electric power, industrial accommodation etc. reduces the investment risks and attracts the prospective entrepreneurs. Arunachal Pradesh being a hilly state and its infrastructural facilities are still under various stages of development.

Transport & Communication

The principal mode of transportation of goods and movement of people intra state as well as inter state is through road due to its better network. Arunachal Pradesh, in particular is much behind the rest of the other North-Eastern states. The state lacks all weather road connectivity in the major areas of the state. The state is yet to find a place in the civil aviation map of the country. Most of the areas of the state are still uninhabited and yet to be explored for want of reliable communication. This has resulted in slow pace of overall development.

Road and rail transport constitute surface transport system. Road transport is virtually the only means of communication to the people of Arunachal Pradesh. Mechanised mode of transport such as rail and airways are yet to gain pace while waterways potential is negligible in the state. An important achievement under surface transport system is that Arunachal Pradesh was brought under railway map of India with the opening of Balipara-Balukpong metre gauge line on 27-01-89.

In December, 1995, Arunachal Pradesh State Transport Department started its maiden bus services operation with two buses. The department at present holds a fleet of 228 buses over 141 routes. This gives 82% of fleet utilisation. In order to provide basic amenities to the passenger 12 bus stations and 11 sub stations are constructed up to 1999-2000. In addition to the above a numbers of waiting sheds have been constructed in various places of the state for the comfort of wayside passengers. For advance reservation in long distance trains to the people of interior places of Arunachal Pradesh, 6 (Six) Railway out agencies are operating at Itanagar (Naharlagun), Along, Pasighat, Bomdila, Seppa and Tawang. The department has also set-up a central workshop at karsingsa for heavy body and mechanical repairing of buses.

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[1] Economic review of Arunachal Pradesh, 2000

Civil aviation

The state of Arunachal Pradesh did not have a place in the air-map of the country till 1995. As a first step towards the effort for development of air-communication, the state govt. introduces flight services through Pawan Hans Helicopters Ltd. (A govt. of India enterprise) with effect from 9th December, 1995 and the affaires are entrusted with Civil Aviation Department.

In view of economic backwardness of the people of the state, the ministry of Home affairs, Govt of India has granted 75% subsidy on the cost operation. The passengers flight service was initially commenced in the two routs viz. Naharlagun-Guwahati and Naharlagun-Mahanbari and it has been subsequently extended to the other locations / district head quarters of the state over the years. At present 12 locations including Guwahati- Mahanbari of Assam are connected from Naharlagun base giving connectivity to nine districts in the state. Plans are on to increase the number of air fleet to two, in order to extend the air-communication network and to cover almost all the district headquarters and important locations.

The Department of Civil Aviation is responsible for the construction of landing grounds, helipads and repair maintenance of existing ones. At present there exits 13 nos. of landing grounds and 120 nos. helipads in the state of which 11 nos. L.Gs and 27 nos. of helipads are regularly used for operation of Pawan Hans passengers flight services and IAF ration sorties respectively.

The civil aviations department is extending human services for the benefit of the people in general and for the Govt. in particular by implementing Civil air-communication flight services and by constructing & maintaining the helipads LGs for smooth operation of ration sorties by IAF air crafts for supply of essential ration commodities to the remote administrative centres.

Post & Telecommunication

Growth of Post and telecommunication facilities under central sectors appears to be at low pace because of remoteness and inaccessibility of many areas. During the year 1999-2000 the number of post offices has been increased from 294 to 301 with the addition of 6 nos. of E.D.P.O and 1 nos. of sub-post office in the state. Out of the total of 301 post offices in the state one is Head Post Office with 46 sub-post offices and 254 EDBPO (Extra Departmental Branch Post Office). Telegraph facilities are provided in 21 post offices. The area served by one post office in Arunachal Pradesh is 296 sq. km whereas the all India average is 22 sq. km(1990-91)

Telecommunication facilities in the state have been growing steadily over the recent years. The state is now divided into seven-telephone sub-divisions viz. Itanagar, Naharlagun, Bomdila, Tezu, Pasighat, Anini and Khonsa. There are 89 telephone exchanges with the total capacity of 51732 connections out of which 30757 working connection have so far been provided as on 31-03-2000. Recently some more facilities have been provided such as 2 nos. of satellite V.T.V with 53 Internet connections and 6 nos. of Electronic Key Board.

Radio Stations are functioning at Tezu, pasighat, Itanagar and Tawang. Very low power transmitters (VLPT) have been set up almost in every district headquarters and a low power TV transmitters has been set up in the State Capital at Itanagar.

Power

The total hydro-power potentiality in the state is estimated to be 1/3rd of the entire hydro potential of the country, where the total hydro potential of the state is estimated to be 30,000 MW. During 8th Five Year Plan and subsequent annual plans, emphasis was given on hydel generation and mini/micro hydel schemes.

The department of power so far has successfully commissioned 35 numbers of the small hydel plants in various parts of the state with an installed capacity of 30.735 MW which are main sources of power in the state. Besides the micro/mini hydel projects, large hydel projects which are under various stages of development total to a capacity of about 26562 MW. As the state's financial resource is inadequate for implementation of these large hydel projects, possibility of exploration through Central Govt. agencies or Private power developers are being explored. However, Ranganadi Hydro Electro Project with an installed capacity 405 MW is already in the stage of completion by North East Electric Power Corporation

The present peak demand of power in Arunachal Pradesh is about 75 MW which is partially met from isolated micro/mini Hydel Stations and Diesel Generating sets with an installed capacity of 55.505 MW only and import of the state's share from central sector projects in the region and from neighbouring states. The generating capacity has been increased to some extend by the end of 8th Five Year Plan. To reduce the gap of demand and generation, priority is given for completion of on-going micro/mini hydel project having total installed capacity of 48.25 MW since the commissioning of major Hydro Electric project would take some time.

Under rural Electrification Programme, the state has so far achieved 65% of electrification by electrifying 2381 nos. of the villages by the end of 1999-2000 out of 3649 villages as per 1991 census.

Bank and Credit facilities

Overcoming disadvantages from remoteness, insecure and unproductive livelihood, the rural poor need legally secure entitlements to assets (especially land and water); technology (above all for increasing the output and yield of food staples); access to markets; opportunities to participate in decentralised resource management; and access to micro-finance. Such policies not only promote economic growth but also help alleviate rural poverty. Credit schemes when integrated into a broader financial package can materially improve the livelihood of the poor. To guard against failure it is important to understand the debt-bearing capacity of the local community, which can be identified through the annual transaction at Banks and other financial institution at the local level. It is observed that the debt-bearing capacity of the local community would differ in the state as the level of poverty are controlled and linked to internal and external influencing factors.

There seems to be no universal formula for providing financial services to the poor, but there is an increasing consensus that

- Interest rates should be market determined
- Lending agencies should be decentralised
- Credit and saving facilities should be provided in tandem as key components to a broader financial services infrastructure, which would ensure the productive utilisation of the local capital and assist local communities meet different needs at different times.

The provision of financial services in rural areas is problematic because of seasonality, the risk associated with agricultural production and the spatial dispersion of potential borrowers.

Credit mechanism at the local level

Effective credit development depends largely on the support services (transport & communication, power, post & telegraph, etc.) available at the local level district/block. Arunachal Pradesh has 99 branches of Commercial Banks with 73 branches located in the rural environment catering to a population of 1091117 (2001 census) and 26 branches in the urban areas catering to a population of 110628, where the average population serve per bank office is 8733. Bank branches have been providing loans in sectors related to agriculture, allied agriculture activities, industries, tertiary sector, and special programmes. State Bank Of India (SBI) provides agricultural term loan /financial assistance in the form of direct finance to farmers-small/medium-and agricultural labourers to create asset facilitating crop production, income generation, land development, minor irrigation, farm mechanisation, plantation and horticulture, waste land development schemes, etc. The repayment period ranges from 6 months to 15 years. The special programmes relating to community development (SGSY, PMRY, KVIC/KVIB margin money scheme, Eri Muga, SHGs, Kisan Credit Card) has been linked to institutional credit and has a loan component. These schemes are implemented through the banks having the maximum number of presence in the rural areas.

Bank and other financial institutions at the local level

The Lead Bank Scheme, introduced towards the end of 1969, envisages assignment of lead roles to individual banks, both public and private sector and the State Bank of India (SBI) is the Lead bank for Arunachal Pradesh. The other banks that operate in the state are the Arunachal Pradesh Co-operative Apex bank, United Commercial

Bank (UCO) Vijay bank, United Bank of India (UBI) and the Central bank. Among all the banks, SBI has the maximum number of branches, with 33 branches in rural location and 9 branches in urban environment. The Arunachal co-operative Apex banks is another institution that has a presence in almost all the districts and supports schemes.

Table 11.1 Distribution of Banking sector in Arunachal Pradesh

District	Sate Bank Of India	AP Co-operative Apex Bank	AP Rural Bank	Other commercial Banks	Total Banks in the district	Population covered	Number of Villages in the district
Tawang	3	2	0	0	5	34705	224
West Kameng	-	1	0	0	8	74595	280
East Kameng	2	1	0	0	3	57065	280
Papum pare	4	5	3	5	17	121750	263
East Siang	3	1	-	0	11	87430	132
West Siang	3	3	5	0	11	103575	406
Upper Siang	1	3	1	0	5	33146	
Upper Dibang Valley				0		57543	
Lower Dibang Valley				0			
Lohit	4	3	0	2	9	143478	
Changlang	4	3	0	0	7	124998	
Lower Subansiri	4	2	1	0	7	97614	595
Upper Subansiri	1	3	1	0	5	54995	
Kurung Kumey		1					

Source, District Credit plan (Lead Bank) State Bank of India

Co-operative Societies and Large Size Multi purpose Societies

The Co-operatives and LAMPS are associated with trading activities and supply of essential commodities. All the societies and the LAMPS are linked to the Arunachal Pradesh State Co-operative Apex Bank Limited. The Lamps avail crop loans for their members through the Apex Bank. Under the revised procedure for implementing of Integrated Rural Development Programme (IRDP), the Lamps are expected to play a larger role and become more active.

Table: 11.2 Distribution of Co-operative socities, LAMPS & other Institutions in Arunachal Pradesh

District	LAMPS	Consumer Societies	Farming Societies	Women Societies	Milk Supply	Marketing & processing	Others
Tawang	2	2			1		3
West Kameng	3	9			1	1	7
East Kameng	1	3	1				3
Papum pare	2	6	1	2	2		12
Lower Subansiri	3	1	4		1	2	17
Upper Subansiri	1	4		1			3
East Siang	3	6	1		5		7
West Siang	3	12	3		1		13
Upper Sinag	1	3					3
Upper Dibang Valley	3	2		1		1	4
Lower Dibang Valley							
Lohit	9	10	2				7
Changlang	4	3				2	5
Tirap	2	8	1				7

Source: Statistical Abstract of Arunachal Pradesh 2000

Performance of Banks under District Credit Plan

Effective credit development depends largely on the support services (transport & communication, power, post & telegraph, etc.) available at the local level district/block. Credit plan at the district level has similar objectives as that of the National Plan and bears a linkage to bank lending and Government programmes. In order to stimulate local initiatives in formulating development programmes through local effort and resources in executing schemes, Community Development (CD) and National Extension Services (NES) block were opened in Arunachal Pradesh. Under the community development programme, emphasis has been given to strengthen infrastructure facilities and covers residual schemes which does not fall under the preview of normal schemes of the Development Department. Schemes.
A mechanism for establishing the linkages to the development trends in the State in terms of investments for the various priority sectors (Agriculture, Industries, Service) and non-priority sectors can be understood from the District Credit Plan. The Annual Credit Plan 2000 – 2001 for the state is represented in table 8.3, which gives an impression of the development effort made by the Government.

Table: 11.3 Performance of Banks under District Credit Plan 2001 - 2002

Banks	Agriculture			Industries			Services			Non priority		
	Com	Ach	%Ach	Com	Ach	%Ach	Com	Ach	%Ach			
SBI	441.63	76.24	17	138 37	32 05	23	672.93	129.54	19			
VIJAY	12.50	4.00	32	16	37	231	35	16.64	48			
UCO	7	26	341	13	28	215	2	76	38			
UBI	4.87	0	0	0.50	0	0	4.50	0	0			
CBI	3.30	1.50	45	9	19	211	14.7	10.1	69			
APRB	250.48	17.79	11	161 57	53 89	33	66	10.5	16			
APSCABL	178.95	34.43	19	35.9	12 24	34	114.8	62.34	54			

Source: State Bank Of India, Lead Bank Department, 2002

Table: 11.4 Banking profile for Arunachal Pradesh, 2001-2002

Category	Bank		
	Commercial Bank	Rural Bank	State Co-operative Apex Bank
Number of Branches	49	19	31
Aggregate deposits	61722	3190	10705
Aggregate advances	7256	3421	4986
Credit Deposit ratio	12%	107%	47%
Advances to priority Sector	4414	1780	2094
Percentage priority sector to total advance	61%	52%	42%
Advances to agriculture sector	1504	800	780
Percentage agriculture advances to total advance	10%	23%	16%
Advances to industries	624	175	181
Advances to weaker sections	2857	1780	461
Percentage weaker sections	64%	100%	22%
Advance to SC & ST	5926	1567	4687
Advances to women beneficiaries	580	49	53

Source: State Bank Of India, Lead Bank Department, 2002

Infrastructure for development of Agriculture & horticulture

Storage & processing

Commodities being used in our daily life are on most occasions maintained fresh in cold storages till their shipment to markets and customers. Getting commodities directly from the producer is not possible at all times, because of reasons like distance between the land where the product is produced and the market where they are sold, season and the demand of the product. Besides producers can avail the requisite support of market price fluctuation by holding back the products as soon as they harvest. In the absence of proper marketing networks and cold storage facilities growers at time sell their produce at throwaway prices and have to succumb to distress selling.

Most rapidly maturing tropical fruits, soft fruits of all kinds, and leafy vegetables with a large surface area tend to have high respiration rates and normally have short storage lives. In contrast, most temperate fruits, cured potatoes and onions, and vegetable root crops often have lower respiration rates and consequently longer storage lives. Therefore depending upon the appropriate requirement, various storages techniques, such as ventilated storage, refrigerated storage, etc. can be introduce. In the state of Arunachal Pradesh only a single cold storage unit exist at Bhalukpung. Similarly micro fruit processing capacities would be an another added advantage, but the present scenario of fruit processing is limited, where only a single fruit-processing unit was set up by the state govt. Nigmoi near Along which has gone sick.

Farmers training

The government realising the importance to training of framers have made investment in training and has developed the farmers training centres promulgating the skills among farmers whereby farmers are encouraged to avail the seed support from the government seed farms, and the government agricultural farms. The distribution of the various support infrastructures relating to direct support for farmers is presented in a tabular form The generated support would help farmers in facing rapid technological advancements and remain competitive, and imparting educational programmes with customised training programmes are the needed of the hour.

Besides Farm Production Analysis Training Course imparted at the training centres can accomplish a number of highly valuable objectives in outreach education. This can be through practical workshop planning and analysis exercises that were useful to them in their individual farm operations. The Farm Production Analysis Training course provided an integrating framework for Extension agents and specialists to work together, pooling their expertise to address a more comprehensive management program.

A sate map representing information on existing infrastructure and those undertaken under 9th and 10 plan for agriculture and horticulture services has been presented in a map.

INFRASTRUCTURE FOR DEVELOPMENT OF AGRICULTURE & HORTICULTURE IN ARUNACHAL PRADESH
Sacle: 1 cm = 70 Kms

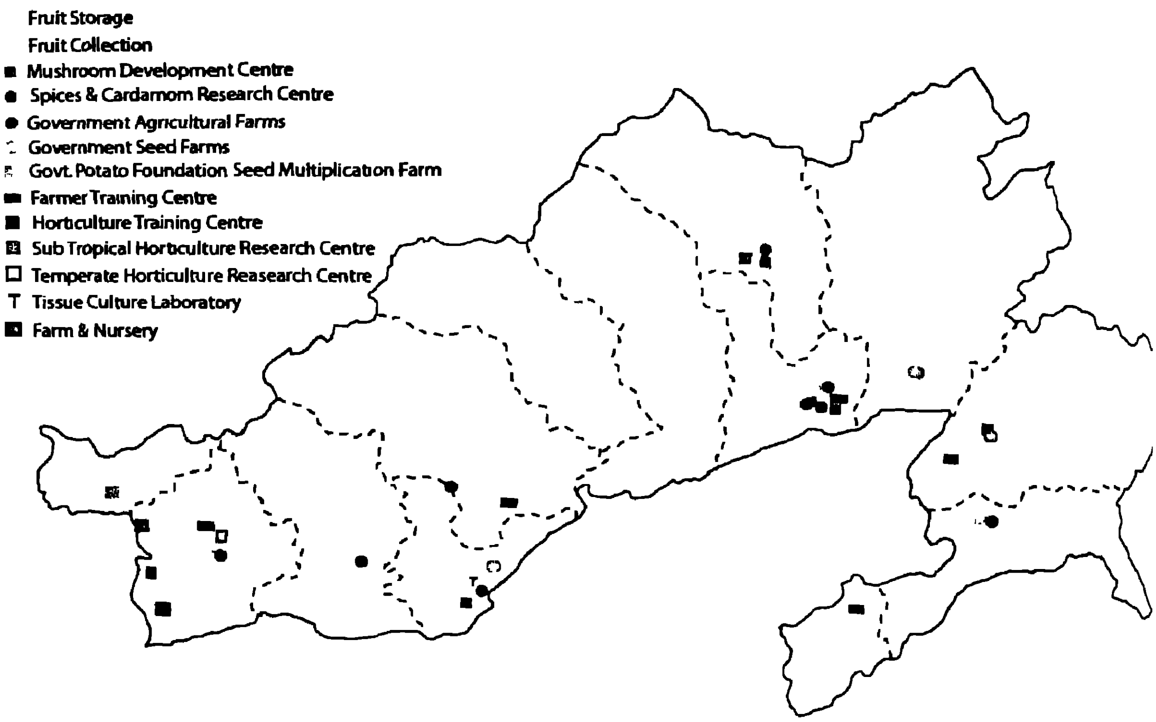

Fruit Storage
Fruit Collection
Mushroom Development Centre
Spices & Cardamom Research Centre
Government Agricultural Farms
Government Seed Farms
Govt. Potato Foundation Seed Multiplication Farm
Farmer Training Centre
Horticulture Training Centre
Sub Tropical Horticulture Research Centre
Temperate Horticulture Reasearch Centre
Tissue Culture Laboratory
Farm & Nursery
T

Table: 11.5 (A) Existing infrastructures for development of agriculture and horticulture:

Sl No		Location	District
1.	Government Agricultural farms	Pampoli	East Kameng
		Pasighat	East Siang
		Yazali	Lower Subansari
2.	Government Seed farms	Jomlo	
		Tezu	Lohit
		Bolung	Dibang Valley
		Sonajuli	Papumpare
3.	Government potato Foundation seed multiplication farm	Tawang	Tawang

Source. Arunachal Pradesh NIC, Resource Atlas, Directorate of Horticulture

Table: 11.5(B) Infrastructure to be available under the 9th plan and 10th plan:

Sl No			Location	District
1.	Central Research Institute on Spice and Cardamom		Yingkiong	Upper Siang
2.	Temperate Horticulture Research Centre		Salari	West Kameng
3.	Sub-tropical Research Centre		Yingkiong	Upper Siang
4.	Tissue Culture Laboratory		Naharlagun	Papumpare
5.	Horticulture cum Training Centre		Shergaon	West Kameng
			Pasighat	Lower Subansiri
6.	Fruit processing centre		Yingkiong	Upper Siang
			Pasighat	East Siang
7.	Fruit collection centre	1	Bomdila	West Kameng
		2	Tawang	Tawang
		3	Seppa	East Kameng
		4	Zero	Lower Subansiri
		5	Itanagar	Papumpare
		6	Daparijo	Upper Subansari
		7	Yingkiong	Upper Siang
		8	Anini	Dibang Valley
		9	Pasighat	East Siang
		10	Tezu	Lohit
		11	Changlang	Miao
		12	Khonsa	Tirap
		13	Along	East Siang
8	Farmers training centre	1	Salari	West Kameng
		2	Pasighat	East Siang
		3	Kheram	Lohit
		4	Ziro	Lower Subansiri
		5.	Deomali	Tirap

Source. Arunachal Pradesh NIC, Resource Atlas, Directorate of Horticulture

12

Assessment of statutory, regulatory and social issues

Arunachal Pradesh was not widely exposed to the rest of the India and the world till the advent of the Britishers in the area. Britishers created the earliest form of inner-line called the posa, which introduced a clan for a kind of suzerainty for some villages over the plains. In the earlier phase of the distant control and non-intervention, the area was a part of the Eastern Frontier of Bengal. The present area of Arunachal Pradesh became an integral part of Assam from 25 September 1914 and the area came under the operation of the Assam Frontier Regulation act of 1880, which put the frontier hills into a new administrative category known as the North Eastern Frontier Tract.

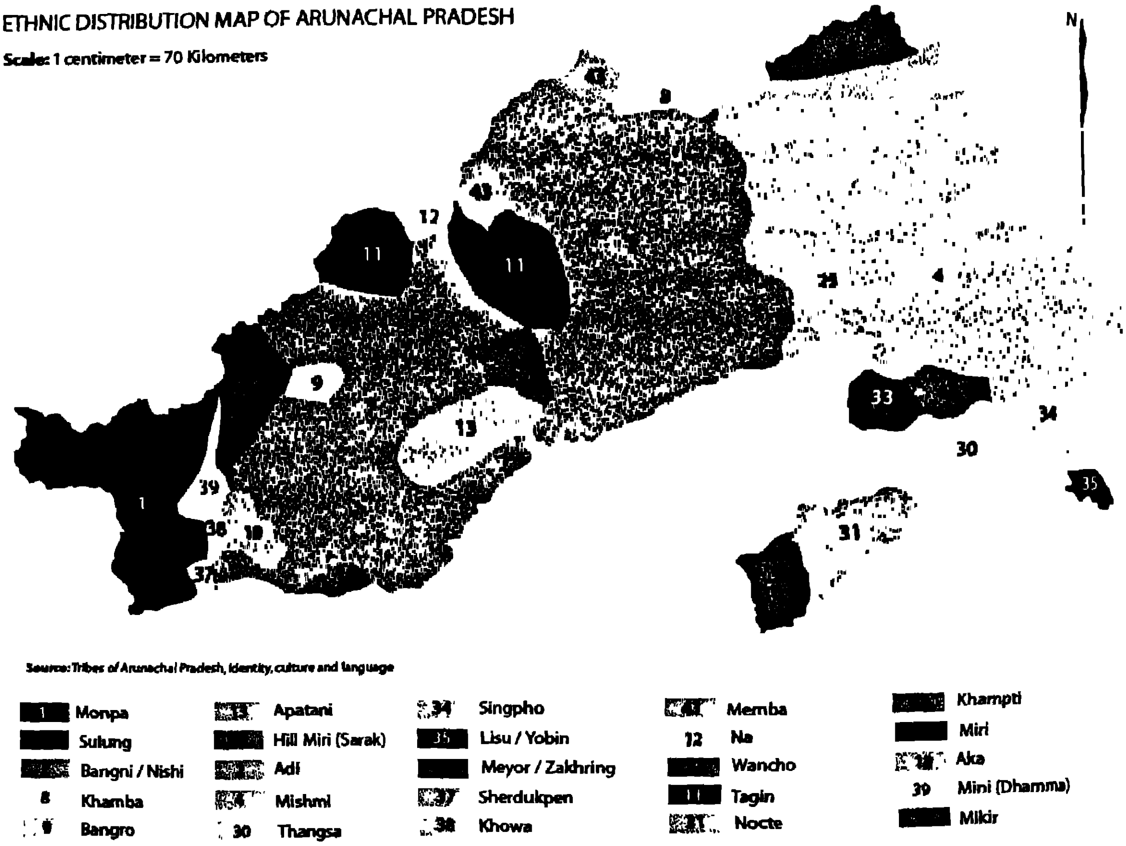
In 1954 the tract was divided into five divisions known as the North Eastern Frontier Agency, and thereafter in 1965 the administrative control was transferred from the External Affairs Ministry to the Ministry of Home affairs. During the year 1972 the North Eastern Frontier Agency, made into a union territory with a Chief Commissioner as the administrative head under Ministry of Home affairs. In 1975 the administrator was designated as the Lieutenant Governor and the territory was granted an Assembly with a Council of Ministers. The next change came with the grating of statehood on 20 February 1987.

The political –administrative changes have provided the scope for the transformation of the whole socio-economic, cultural and political life of the traditional tribal society of Arunachal Pradesh. The age-old traditional system of village administration started witnessing a change and at times functioning concomitantly parallel to the formal administrative Institutions. The Regulation Act of 1954 has restricted the village authority and the traditional or customary laws of justice, where powers were transferred to political officer for administration of justice.

Through the act remained, the government initiated the policy characterised by protective and development aspect. The first aspect is related to protection of rights of indigenous communities on land and forest of the area and their culture. The later aspect is related to the positive welfare schemes. Administration in Arunachal Pradesh exhibits the systematic concern and traits of local tribal Instutions, customary practices, combined with the modern three-tier system of panchayat raj and community development ensuring participation and development without losing their identity.

Ethnic distribution in Arunachal Pradesh

Arunachal Pradesh, a homeland of Indo-mongoloid tribes and sub-tribes, speaking about seventy dialects with a total population of -------- (2001 census) are distributed through out the state according to the migration pattern. The migration pattern indicate that the North Western tribes and tribes of Central Arunachal Pradesh came from Southern and South Eastern Tibet, through the valley and gorges settling in some stages and changing directions at times and finally settling in the present locations. All the tribes to the resent places through various stages have mixed with other tribes or have been pushed by others tribes or have moved in search of better security or pasture. An ethnic distribution pattern map is presented which would help in correlating area specific programmes.



ETHNIC DISTRIBUTION MAP OF ARUNACHAL PRADESH

Scale: 1 centimeter = 70 Kilometers

Source: Tribes of Arunachal Pradesh, Identity, culture and language

Customary laws

Customary law in Arunachal Pradesh are not written and confined but memorised out of knowledge and experience. The logic of laws and arguments are deducted and interpreted from the point of view of the prevalent customs and traditions of the society and therefore an act of omission and commission is held as a crime taking into consideration the overall welfare and convenience of the society and the decree of harm caused by the victim.

Evidenced required to be adduced to prove a case are simpler and logically ascertained and availability of direct and conclusive evidences is not always necessary to prove a case. However under circumstances when an accused refuses to accept the allegation then the village authority or the clan can restore to an oath taking or ordeals of magico-religious methods of proving a crime.

Local tribal customs or laws

The traditional village or tribal council of the people constitute a system of local self-government in Arunachal Pradesh. these councils may vary from tribe to tribe in composition, powers and privilege, but they have certain features in common. They are all time honoured institution deriving their authority from traditions. They function as village governments expressing the will and power of all the members of the society. All the councils are informal in character and are constituted by elderly, influential and respected members of the village. But all the villagers may take part in the deliberation of the of the council. Every participating villager is regarded as a member of the council in session, and he is at liberty to speak out before the general assembly, even though the final say is the prerogative of the village elder.

The village council is a democratic institution where all the vital problems (criminal cases, adjudicated, social and agricultural matters) concerning the village is discussed freely and publicly and solved. No formal vote is necessary for a decision and the discussion continues until a consensus is reached. Each village select their headman who is the chief, or "gam" who is responsible for the welfare for the village. All the tribal council functions within the general framework of the Assam Frontier (Administrative of Justice) Regulation. 1945 (Regulation I of 1945), which confers on them considerable powers. The functions of the village council are three folds – Judicial, administrative and development. On the judicial side, the council settles all disputes arising at the village and gives verdict on serious crimes committed against the society, but not against the government.

The legal procedure of the council does not entail any amount of expenses and the service is free of cost and no one is denied justice for his inability to pay as is otherwise is necessary to pay. The council allows the defendant and the complainant to plead for themselves, and the judgement is given in accordance with the customary law after a careful consideration of the divergent statements.

The administrative jurisdiction of the council extends to the maintenance of paths and bridges, supervisions of water-supply and sanitation of the village, fixation of the dates for community hunting and fishing, taking decision as to when the main agricultural operations should take place and when festivals should be held.

The function of the council on the development side is a new aspect and depends largely on the calibre of the leaders and the local officials.

Communalistic notions of land and tribal councils:

In all of these groups there is a complex mix of individual and community rights to property. Shifting horticulturalists such as the Nishi, the Adi and the Miri tend to have the least corporate notions of political structure. Being semi-nomadic and needing to keep reapportioning access to land as they move their holdings, they have flexible decision making networks. Ultimately all land is understood to be communally held by clans which apportion specific plots at specific times according to informal decision-making within clans and lineages. The boundaries to these holdings are loosely defined.

The Nishi have no stable socio-political units larger than the lineages, and traditionally live together in long houses with as many as 60 to 70 people, warlike and unruly. Elwin describes intermediaries called *gingdungs,* who arranged for ransom and could call councils called *nele* to which all concerned people could come for debate {Elwin 1988, 154}.

The Adi on the other hand are renowned for having the 'most highly developed tribal councils' in Arunachal Pradesh {Elwin 1988, 157}. Each village had a chief and a council, called the *kebang,* which was held in the village hall, called a *morang.* These councils were large affairs which highly elaborated debate in which all villagers could participate. The Miri are reputed to have no suprahousehold organization but they have been little studied.

The high altitude groups, being influenced by Tibetan Buddhism, tend to have more corporate and defined notions of religious and political authority. Spiritual power is invested in Buddhist lamas, with a special institutional focus on the large Tawang Monastery in Kameng District. Being sedentary agriculturalists, land ownership is more defined and is transmitted through lineages. Some groups have a marked social stratification between lineages and clans. Typical of these village councils is a method of dispute resolution in which the 'convicted' party is responsible to host costly celebrations which help reestablish social harmony. The village council of the Monpa was called the *lengui* and had wide powers.

The Aka and the Miji also had councils but the largest two villages were reputed to have *ranis* (or 'queens). The Sherdukpen were dominated by aristocratic families, but had a village council called the *jang.*

The political organization of the lower altitude ApaTani has been the best described. They have developed the capacity to raise two annual crops and are famous for their ability to use and develop even the smallest plots of land. This extremely efficient use of a small area is made possible by a very tightly organized corporate village

structure. Each village has councils called *buliangs* which are made up of male representatives from each clan. There are 3 *buliangs*-- which are graded by age, with the most powerful being the one for men who are past active economic roles. These councils regulate their elaborate ritual cycle and resolve disputes. There were three types of land ownership: individual ownership of land, groves of bamboo, pines, fruit trees, and of homes and granaries; clan owndership of assembly platforms, pasturage, burial grounds and hunting; and common village ownership of pasturage and forests. Other social groups which fostered a sense of collectivism were the important collective work groups called *patang*.
The Mishmi resemble the Nishi in having weak village structures, but do have a council called the *abbala*. At the other extreme are the Wancho, Nocte and Tangsa which are quite hierarchical and corporatized with powerful chiefs and aristocratic classes.

Land ownership pattern and ways of farming

No land legislation is available in Arunachal Pradesh, and the only legal framework for determining the rights to cultivate land is the Jhum Land Regulations of 1947, where the rights of tribes associated with Jhum cultivation on the area operated has been accepted. Besides as there has been no Cadastral survey on land ownership, no land record is available.

Land ownership and individual rights to use are determined by tradition and customs of the local communities. Land disputes are settled at the village council and judgement awarded by the council is final and binding for the people. Even though the numerous tribes (20) have different customs and traditions but there is a unified customary law. The methods of agriculture practised by the people depend on ecological conditions and are mainly three types, namely shifting or Jhum, permanent or wet/sedentary and mixed type. Land under Jhum cultivation is under community ownership, and plots are allotted to families according to their need and capacity to utilise them. The jhum Land Regulation , 1947 defines the jhum land as follows.

"Jhum Land means and includes all land which any member or members of a village or a community have a customary right to cultivate by means of shifting cultivation or utilise by clearing jungle or grazing livestock, provided that such village or community is in such location, but does not include:

- Any land which has been or is under process of being terraced for the purpose of a permanent or semi–permanent cultivation whether by means of irrigation or not , or

- Any land attached or appurtenant to a dwelling house and used for the purpose or permanent cultivation, or
- Any land which in the opinion of the Political Officer is subject to permanent cultivation.

Private or family ownership with heredity rights on land occurs on land where the members or community of local tribal societies have taken up permanent cultivation. Corresponding to these types the land is held by the people under three broad based categories of ownership, which relates to right of land and management of land, where the categories are

- Village or community land
- Clan land, and
- Individual land

The village land includes peripheral forest areas and grazing grounds. The forest areas are utilised for, gathering food, herbs, hunting and collection of minor forest produce. In the land where shifting cultivation is followed, all land in principle belong to the village[1]. The pattern of individual possession of land where communal ownership is the rule varies from tribe to tribe. In the past villages used to be coexistent with single clans and where exceptions occurred, the right of cultivation of community land was adjusted within the framework of village land.

Clan land includes pastures, forest tracts, sites for public assembly inside the village and burial grounds.

Individual ownership of land is either by inheritance or by purchase, and inheritance of land varies according to the tribes. In most of the tribes the eldest son of the family generally inherits, but in some the parental property is divided among the male members. No female member inherits the land property, and in absence of a male issue the property remains with the widow during her lifetime, which later on passes to the nearest member of the clan. The selling and purchase of land is possible within the village community only. The individual right of cultivation and possession continues through the cycle of agriculture operations and remains suspended during the fallow period. All fences are removed during the fallow period and the land is open for grazing.

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[1] According to Jhum Land Regulation 1947, members of the village community have a common right to cultivate jhum land by the shifting method

Forest laws and tribal societies

Forest is the home of the indigenous communities of Arunachal Pradesh, which provides shelter, food and raw material fulfilling day to day requirements. Forest and forest land is considered as the private and landed property in Arunachal Pradesh. Hence as a matter of practise each community, clan, village has its own forest land where they enjoy total freedom to use it products.

Each clan or the village community has land under it jurisdiction, where Jhum and settled agriculture is being carried out for sustenance. On account of total dependence upon forest for their very sustenance, the constitution of India offers safeguard for the welfare of the Schedule Tribes. However the National Forest Policy of 1894 and 1952 are recent happenings compared to the long chronicle of the indigenous communities. The National Forest Policy of 1988, is elucidated as follows.

The rights and concessions, including grazing should always remain related to the carrying capacity of the forest. The capacity should be optimised by increased investment, silviculture research and development of the area. The requirements of the community which cannot be met by the right and concessions so determined should be met by development of social forestry outside the reserve forest.

The holders of the customary rights and concession s in forest areas should be motivated to identify themselves with the protection and development of the forest from which they derive benefits. The rights and concessions from forest should primarily be for the bonafide use of the community living within and around the forest areas.

The right and concessions of poor indigenous communities living near the forest should be fully protected. Their domestic requirements of fuel wood, fodder, minor forest produce and construction timber should be the first charge of forest produce. These and substitute materials should be made available through continently located deports at reasonable price.

Wood is in short supply and the long-term solution for meeting the existing gaps lies in increasing the productivity of forest and providing substitutes for industrial and construction applications. Similarly fuel wood for domestic applications needs to be substituted with alternate fuel sources like biogas, LPG and solar energy. Fuel-efficient Chula as a measure of conservation of fuel wood need to be popularised in rural areas.

National Forest Policy, 1952[2]

This policy had the following to say regarding forest tribals interface. Claims of neighbouring Communities: Village communities in the neighbourhood of a forest will naturally make greater use of its products for the satisfaction of their domestic and agricultural needs. Such use, however, should in no event be permitted at the cost of national interests. The accident of a village being situated close to forest does not prejudice the right of the country as a whole to receive the benefits of a national asset.

National Forest Policy, 1988[3]

Relevant sections in relation to Jhum and development of horticulture in Arunachal Pradesh with respect to the National Forest Policy of India has been presented for and understanding of the implication for any rehabilitation effort in Jhum cultivation areas.

Essentials of Forest Management

Existing forests and forest lands should be fully protected and their productivity improved. Forest and vegetal cover should be increased rapidly on hill slopes, in catchment areas of rivers, lakes and reservoirs and ocean shores and on semi-arid and desert tracts.

Diversion of good and productive agricultural lands to forestry should be discouraged in view of the need for increased food production.

For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately. Provision of sufficient fodder, fuel and pasture, specially in areas adjoining forests, is necessary in order to prevent depletion of forests beyond the sustainable limit. Since fuel-wood continues to be the predominant source of energy in rural areas, the programme of afforestation should be intensified with special emphasis on augmenting fuel-wood production to meet the requirement of the rural people.

Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income.

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[2] Tribal Laws & Modern Legal System. Are we Sincere towards tribal. C.P.Obeori.

[3] Ministry of Environment & Forest, Govt. of India. 2003

Stratagey

Area under Forest

The national goal should have a minimum of one - third of the total land area of the country under forest or tree cover. In the hills and in mountainous region, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system.

Afforestration, Social forestry & Farm Forestry

A massive need-based and time bound programme of afforestation and tree planting, with particular emphasis on fuel-wood and fodder development, on all degraded and decuded lands in the country, whether forest or non-forest land, is a national imperative.

It is necessary to encourage the planting of trees alongside of roads, railway lines, rivers and streams and canals, and on other unutilised lands under state/corporate, institutional or private ownership. Green belts should be raised in urban/industrial areas as well as in arid tracts. Such a programme will help to check erosion and desertification as well as improve the microclimate.

Village and community lands, including those on foreshores and environs of tanks, not required for other productive uses, should be taken up for the development of tree crops and fodder resources. The government should provide technical assistance and other inputs necessary for initiating such programmes. The revenues generated through such programmes should belong to the Panchayat's where the lands are vested in them; in all other cases, such revenues should be shared with the local communities in order to provide an incentive to them. The vesting in individuals, particularly from the weaker sections (such as landless labour, small and marginal farmers, scheduled castes, tribals, women) of certain ownership right over trees, could be considered, subject to appropriate regulations; beneficiaries would be entitled to usufruct and would in turn be responsible for their security and maintenance.

Land laws should be modified wherever necessary so as to facilitate and motivate individuals and institutions to undertake tree-farming and grow fodder plants, grasses and legumes on their own land. Wherever possible, degraded lands should be made available for this purpose either on lease or on the land should be subject to the land grant rules and land should be subject to the encourage them to do so must be taken. Appropriate regulations should govern the felling of trees on private holding.

Management of State forest

Schemes and projects, which interfere with forests that clothe steep slopes, catchments of rivers, lakes, and reservoirs, geologically unstable terrain and such other ecologically sensitive areas, should be severely restricted. Tropical rain/moist forests, particularly in areas like Arunachal Pradesh, Kerala, Andaman & Nicobar Islands, should be totally safeguarded.

No forest should be permitted to be worked without the Government having approved the management plan, which should be in a prescribed format and in keeping with the National Forest Policy. The Central Government should issue necessary guidelines to the State Government in this regard and monitor compliance.

In order to meet the growing needs for essential goods and services, which the forests provide, it is necessary to enhance forest cover and productivity of the forests through the application of scientific and technical inputs. Production forestry programmes, while aiming at enhancing the forest cover in the country, and meeting national needs, should also be oriented to narrowing, by the turn of the century, the increasing gap between demand and supply of fuel-wood. No such programmes, however, should entail clear felling of adequately stocked natural forests. Nor should exotic species be introduced, through public or private sources, unless long-term scientific trails undertaken by specialists that they are suitable and have no adverse impact on native vegetation and environment.

Rights and concession

The rights and concessions, including grazing, should always remain related to the carrying capacity of forests. The capacity itself should be optimised by increased investment, silvicultural research and development of the area. Stall-feeding of cattle should be encouraged. The requirements of the community, which cannot be met by the right and concessions so determined, should be met by development of social forestry outside the reserved forests.

The holders of customary rights and concessions in forest areas should be motivated to identity themselves with the protection and development of forests from which they derive benefits. The rights and concessions from forests should primarily be for the bonafide use of the communities living within and around forest areas specially the tribals.

The life of tribals and other poor, living within and near forests, revolves around forests. The rights and concessions enjoyed by them should be fully protected. Their domestic requirement of fuel-wood, fodder, minor forest produce and construction timber should be the first charge on forest produce. These and substitute materials should be made available through conveniently located depots at reasonable prices.

Similar consideration should be given to scheduled castes and other poor living near forests. However, the area, which such consideration should cover, would be determined by the carrying capacity of the forests.

Wood is in short supply

The long-term solution for meeting the existing gap lies not only in increasing the productivity of forests, but also relieving the existing pressure on forests for the demands of railway sleepers, construction industry (particularly in the public sector), furniture and paneling, mine-pit props, paper and paper board etc. Substitution of wood needs to be taken recourse to. Similarly, on the front of domestic energy, fuel-wood needs to be substituted as far as is practicable with alternate sources like bio-gas, LPG and solar energy. Fuel-efficient "chulhas" as a measure of conservation of fuel-wood need to be popularised in rural areas.

Wild life conservation

Forest Management should take special care of the needs of wildlife conservation, and forest management plans should include prescriptions for this purpose. It is specially essential to provide for corridors linking the protected areas in order to maintain genetic continuity between artificially separated sub-sections of migrant wildlife.

Tribal people and forest

Having regard for the symbiotic relationship between the tribal people and forests, a primary task of all agencies responsible for forest management, including the forest development corporations, should be to associate the tribal people closely in the protection, regeneration and development of forests, as well as to provide gainful employment to people living in and around the forest. While safeguarding the customary rights and interests of such people, forestry programmes should pay special attention to the following:-

One of the major causes for degradation of forest is illegal cutting and removal by contractors and their labour. In order to put an end to this practice, contractors should be replaced by institutions such as tribal cooperatives, labour cooperatives, government corporations, etc as early as possible;

Protection, regeneration and optimum collection of minor forest produce along with institutional arrangements for the marketing of such produce;

Development of forest villages on par with revenue vilages;

Family oriented schemes for improving the status of the tribal beneficiaries ; and undertaking integrated area development programmes to meet the needs of the tribal economy in and around the forest areas, including the provision of alternative sources of domestic energy on a subsidised basis to reduce pressure on the existing forest areas.

Shifting cultivation

Shifting cultivation is affecting the environment and productivity of the land adversely. Alternative avenues of income, suitably harmonised with the right land-use practices, should be devised to discourage shifting cultivation. Efforts should be made to contain Jhum cultivation within the area already affected, by propagating improved agricultural practices. Area already damaged by such cultivation should be rehabilitated through social forestry and energy plantations

Damage to forest from encroachment, fires and grazing

Encroachment on forestlands has been on the increase. This trend has to be arrested and effective action taken to prevent its continuance. There should be no regularisation of existing encroachments.

The incidence of forest fires in the country is high. Standing trees and fodder are destroyed on a large scale and natural regeneration annihilated by such fires. Special precaution should be taken during the fire season. Improved and modern management practices should be adopted to deal with forest fires

Grazing in forest areas should be regulated with the involvement of the community. Special conservation areas, young plantations and regeneration areas should be fully protected. Grazing and browsing in forest areas need to be controlled. Adequate grazing fees should be levied to discourage people in forest areas from maintaining large herds of non-essential livestock.

Forest Conservation Act

Forest conservation Amendment Act 1988 defines cultivation of tea, coffee, spices, rubber, oil bearing plants, horticulture crops and medicinal plants as non forest use. Though subsequent guidelines issued by the environment minister (24th Oct. 1989) mention that planting of fruit bearing, oil bearing & medicinal plants will not be construed as non forest use, if the spices are indigenous to the area in question, guide line-being mere administrative instructions do not have the force of law and can not override the all powerful F© Act. Medicinal plants of life saving nature are commonly grown in tribal areas including the forest area. Tribal sub plan strategy envisages that beneficiary oriented programmes under horticulture, oilseeds, tea, coffee, sericulture etc. should be taken up by tribals so as to enable a least 40 lakhs tribal families to come over the poverty line. There is need for bringing harmony between TSP and Forest conservation Act.

Environment and Forest[4]

The socio-economic life of the people of Arunachal Pradesh, depends directly upon forests for fuel wood, house building materials, timber and other minor forest produce. Therefore62% of the total forest areas of the state is under unclassed forest where the local people exercise their traditional right. Forests in Arunachal Pradesh cover an area of 51540 Sq. km. and from about62% of the total geographical area of the state. Nearly, 10178 Sq.km of forest area has been surveyed, demarcated and notified as Reserved forest. Anchal and village reserve forest provides basis for their scientific management and sustainable use. At the end of 8th plan, an area of 7401 sq.km. has been brought under APNAVAN scheme. The schemes "Apnavan" and "Decentralised peoples' Nursery" are also being implemented with the active participation of the people

So far ten active Wildlife Sanctuaries and two National Parks covering a total protected areas of 9483 sq. km. for conservation and preservation of rich biological diversity of the state has been created. About 500 species of orchids, which grow on ground, rocks or on trees attracting attention with various shapes and brilliant colours have developed for commercial exploitation in the peoples sector. Arunachal Pradesh Forest Department has established an orchid Sanctuary with Research station at Tipi near Bhalukpong under West Kameng District covering an area of 100 sq. km.

Most of the wood based industries like swa Mills and plywood Mills which provided employment to local people are not functioning in the state due to ban on felling of trees by the Hon'ble Supreme court of India

A state Forest Research Institute at Van Vihar, Itanagar with multidisciplinary staff is engaged in survey/ scientific research work in the field of silviculture, Forest Botany including medicinal plants, Zoological research, forest genetics etc. for providing developed technology in forestry developmental programmes.

The Arunachal Pradesh Forest Corporation Ltd (APFC Ltd) which came into existence from the year 1977 is being engaged to eliminate the agency of forest contractors and to improve the utilisation of forest produce and to tap institutional finance, develop cultivation of cash crops like coffee, tea etc. Besides, the Namsang-Barduria village forest of Tirap District is being managed by the APFC Ltd. and a portion of the revenue earned through management of the forest is being utilised to promote a number of welfare programme in Tirap District.

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[4] Economic review of Arunachal Pradesh, 2000

The objectivity of the forest activities is towards restoration of vegetative cover through various plantation schemes and the department has made this headway gradually through the Five Year Plans. The approved outlay for 9th plan in respect of forestry and wildlife was Rs.6811 lakhs.

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Identification of project implementation agency

As the watershed concept has been identified as the measures to bring about transfer of technology for a holistic development of agriculture, horticulture and allied activities in an area taking into account the various kinds of land use based on crop, horticulture, agro-forestry and forestry. Guidelines under the National Watershed Development Project for Rainfed Areas (NWDPRA) programme under the Ministry of Agriculture, would be ideal where planning, implementation, monitoring are undertaken by the watershed community, making it a peoples movement for the development of land and water resources and enhancement of productivity on a sustained basis.

Management of natural resources under the watershed programme would include, cultivated, land under rainfed agriculture, under Jhum cultivation, fallow land, uncultivable land, land under Panchayat, individual and community land, with an objective to increase food productivity and diversify the existing farming system. It is desired to have special focus on Integrated Pest Management (IPM), Integrated Nutrient Management (INM), Farming System Approach (FSA), Low External Input Sustainable Agriculture (LEISA), forestry, agri-horticulture, etc. The comprehensive approach through watershed approach would not only improve crop productivity, but also improve the overall production of biomass (in term of non-timer forest produce) resulting in additional income for the rural household.

The *Directorate of Agriculture and Horticulture*, Government of Arunachal Pradesh would be the ideal agencies for facilitating the watershed programme through their extension at the district level. The District offices of the Directorate of Agriculture and Horticulture can be proposed for undertaking the role of the Project Implementing Agency (PIA), which would be supported by their infrastructures like the farmers training centres, seed farms, etc. and through the convergence of activities / schemes of the various government departments.

The guidelines for the conservation and development of the shifting cultivation areas would necessarily need to consider some of the main elements as a guiding principle, which would essentially be conservation of natural resources, integrated development of sustainable farming system, adoption of ridge valley approach, production enhancement activities for land owners and livelihood support for landless, democratic and decentralization in decision making, direct funding to the community through the supervision of the PIA, build indigenous innovations, initiatives and ideas, equity for the resource-poor families and empowerment of the women and finally moving away from subsidy to a self reliant development.

The watershed programme would be initiated through community-based institutions, Government Departments, Panchayat and Research Institutions (TERI) would undertake the role of the PIA in a inter-connective pattern of approach. The role of the PIA would be to facilitate the formation of new local level institutions, identify the existing institutions and categorise the role to be played. The PIA would facilitate the process and act as a catalyst to the process of development. The institutions that would play a vital role in the process have been elaborated below.

Institutions to be organised

Four types of groups are to be organised at the village level namely: Self-Help Group (SHG); User Group (UG); Village level Watershed Committee (VWC), Watershed Committee (WC). A proper sequence has to be followed while organising the groups in order to minimise conflict among the community members. The formation of the WA should be kept as last and final activities. Volunteers for the project can be identified during the process of various group meeting to be organised at the village level.

Self Help Groups

The Self-Help Groups (SHG) would be formed with the theme of saving and credit and would be a contingent for collective action. SHGs that would mature can help in convergence of activities of different developments departments, and would work together with the user groups and the watershed committee for convergence of individual and community oriented schemes available with the Government departments. The objective of organising and strengthening the SHGs is to regulate the flow of resources with the area and build them as social and functional units that would effectively manage need-based activities

User Groups (UG)

For the different work component that would be identified through the PRA and village level meetings, the WCT & the VWC would identify a group of people who would be affected, either beneficially or adversely. The WCT & VWC would be responsible to see the economic and social interest of beneficiaries within the treatment area and find out ways and means in reconciliation of the differences in interest, find ways for co-operative work toward a holistic development approach. The solutions for specific problems would be found out within the locality and from those affected. Identification and assessment of civil structures, ponds, farm ponds, drainage area treatment, act has been based on community driven approach and WCT has been a facilitator. Thus the user group would be the key constituent for actual implementation of the developmental activity.

Village Watershed Committee (VWC)

For an effective implementation of the programme it is important that individual villages have their own bodies responsible for activating the local community, identifying intervention areas and thereafter proceed for a time framed implementation. The VWC would operate in similar principle as the WC in all aspects.

Watershed Committee

The villagers of the watershed area in their general body meeting would elect nine representatives from among themselves with adequate representation of SHGs, UGs as members of the watershed committee. The Gram Panchayat and the PIA/WCT would nominate one member each as their representative. The general body / WA would also nominate the chairperson for the WC during the time of formation of the WC. The term of the WC members would be for two years. The PIA and the WC shall carry out the day to day activities of the watershed development project. The WC shall report the progress of the works and the utilisation of funds to the villagers and the facilitating (Grant making) agency two months.

Watershed Association (WA)

After the organization of SHGs/ UGs, VWA the PIA would call for a General Body meeting of all members of the above groups and also other participants representing the households within the watershed area. The Watershed Association will be the General Body comprising all members of the Watershed Community in the watershed development project. This body would be formally registered under Societies Registration Act. The WA shall evolve its working procedures with reference to NWDPRA guidelines / Funding Agency after electing its President. It will meet preferably once in three months, to assess the overall development and come out with solutions in areas of constraint. The WA would carry out review of progress during implementation phase.

Institutional arrangements

Institutions (formal and non-formal) that would operate within the micro-watershed area has an important role (table 10.1) to play during the implementation. Development activities of these institutions are inter-linked and it is desired that maximum output is availed for overall development. In order to do so, linkage and co-ordination through effective networking of these institutions is desired. An important element of long-term sustainability is to forge linkages of watershed institutions with permanent institutions in the area, particularly the Panchayat Raj Institution (PRI), DRDA. The gram Panchayat by appointing a member to the WC would be to become an extended wing of the Project Implementation Agencies.

Table 13.1 Intuitional arrangement

Institution	Institution in the watershed	Role in the watershed
Non-formal institution	Self help groups	▪ Set-up revolving fund ▪ Undertake income generating activities
	Mahila Samities	▪ Programmes on literacy,family welfare,Social services
	VWC	▪ Responsibility for village level Watershed Conservation & development.
	Water user group	▪ Tank management for irrigation ▪ Upkeep of irrigation channels
	CFM committee	▪ Develop Block plantation for vegetative cover ▪ Maintenance ▪ Sharing of the forest produce
	Small groups	▪ Undertake Microenterprise
	User Groups	▪ Maintenance of rural infrastructure
Formal Institutions	Angawadis, Youth Club Mahila Samities (registered)	▪ Generating peoples participation ▪ Programmes on literacy,family welfare,Social services ▪ Awareness on Health & Sanitation
	Self help groups (registered)	▪ Set-up revolving fund ▪ Undertake income generating activities
	Co-operative societies	▪ Distribution of seeds & fertilisers ▪ Marketing & Storage
	Gram Panchayat	▪ Technical support and in secondary data. ▪ Maintenance of village road & rural infrastructure ▪ Post Watershed Conservation & development in the area
	Banks	▪ Credit & savings
	Department of Agriculture	▪ Crop management ▪ Agriculture extension ▪ Support to agriculturist
	Department of horticulture	▪ Crop management ▪ Horticulture extension ▪ Support to horticulturist
	Department of forest	▪ Joint forest management ▪ Social forestry ▪ Nursery raising, supply of plants and seeds
	Department of Animal husbandry	▪ Livestock development ▪ Veterinary services
	Block development office	▪ Linkage to other developmental programmes
	Non Governmental Organisations	▪ Awareness creation & Implementation of various socio-economic & environmental programmes
	Watershed Committee	▪ Support in implementing the watershed conservation & development ▪ Liasoning with Gram Panchayat, WCT/ PIA, ZP and other Government Agencies
	Project Implementing Agency	▪ Systematic exploration of problems and opportunities ▪ Technical know-how and scientific intervention ▪ Planning, implementation & management of watershed development programmes

Memorandum of Understanding (MOU) between PIA and WC, WC & VWC

For an effective and smooth functioning of the institution in the watershed, it is important that an MOU between the different parties are signed. The MOU would be a formal mechanism of imparting responsibilities for accountability. It is desirable that an MOU between the PIA and WC on behalf of the WA be signed and an MOU between WC and VWC during the commencement of the project.

Operational cost of the committees /agencies

Depending upon problems prioritized at the different districts/blocks, under Jhum/Sweden agriculture, the project fund allocation can be divided under treatment/development works, community organization, training, administrative overheads, and the fund share is allocated in terms of percentage.

Table 13.2: fund allocation under different heads for watershed activity

1	Watershed Treatment/Development Works/Activities	80%
2	Watershed Community Organization including entry point activities	5%
3	Training	5%
4	Administrative Overheads	10%
	TOTAL	100%

14

Marketing network and market assessment

Agricultural marketing is undergoing a significant transformation considering the economic liberalisation and globalisation Infrastructure development is the critical factor determining market strategies and macro-economic policies in developing countries. A number of measures have been taken by the government to protect the benefits of farmers, through market regulations, grading, co-operative marketing, etc. But the benefits have not been able to percolate down to the framers in absence of correct and timely market information and advise upon arrivals, prices and market trends, etc.

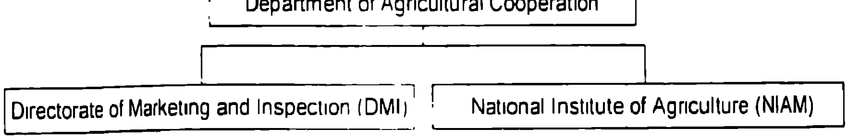
Fruits and vegetables are highly perishable living parts of plant and contain 65 to 95 % water. Their post-harvest life depends on the rate at which the stored food reserves are used and rate of water loss. Efficient marketing of fruit is an important aspect related to post-harvest management and determines the investment for infrastructure relating to storage and related processing. A sound marketing system with latest information on prices and arrivals can help direct consignments to the markets where prices predominates ensuring better return for growers. Creating an effective agricultural marketing at the local level calls for an assessment of associated key factors:

- Assessment of Market infrastructure (weight and measures, contract enforcement, etc.) adequate to encourage private traders to enter.
- Public information and statistical service to transmit price and planting information.
- Provision of production credit and inputs linked to parastatal purchasing under the old system.
- Mechanisms to identify and safeguard against unfair trading practices.
- Collection /payments of taxes and/or levies on production
- Assessment of the marketing chain, and location of the storage of produce be concentrated (e.g on-farm, with small traders, with wholesalers) and effective sizing of storage under different applications.
- Efficiency of the private sector, and availability of rural credit/capital to cover start up cost, stock holdings and establish marketing effort.

- Capability of local entrepreneurs on book-keeping, quality control, marketing (export), processing, packaging and finally communicating /bargaining skills with potential buyers.
- Role of private sector associations, such as the chamber of commerce, that can help regulate trade and in case of market abuse.
- Connectivity through road, rail and other communication facilities.

In most of the countries over the world there is a state intervention in the agricultural produce marketing sector. The rationale being that it would help risk reduction and safeguard national food security and safeguard the interest of poor and marginal farmers living in remote locations through pan-territorial pricing. Large fluctuations in food pricing can lead to price instability effecting livelihoods and political destabilisation.

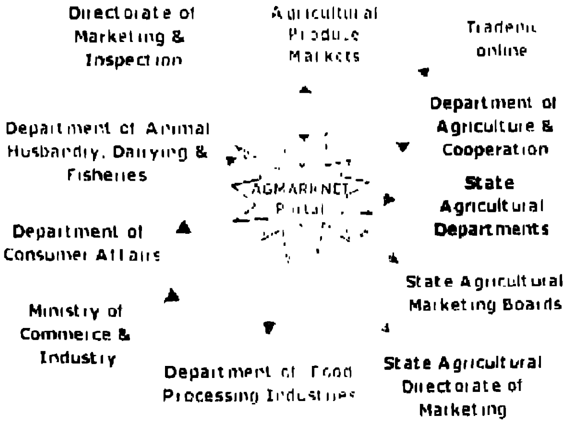
Government of India has been promoting the agricultural marketing system through the department of Agriculture and Co-operation, with two organisations dealing with marketing under its administrative control, namely the Directorate of Marketing and Inspection (DMI) and the National Institute of Agriculture (NIAM). DMI renders advis on Statutory regulations, development and management of agricultural produce, promotion of grading and standardisation of agriculture and allied products under Agriculture (Grading and Marketing) Act, 1937, market research, survey and planning, training of personels in agriculture marketing, etc. DMI has a Regional Office at Guwahati catering to the requirement of quality control for internal trade in the North Eastern States. In order to further strengthen the services and activities an AGMARK laboratory is being established at Shillong. NIAM imparts training to senior and mid level executives of the agriculture and horticulture departments, Agro Industries Corporation, apex level co-operatives, commodity boards, export houses recognised b APEDA, Government and non-government organisations, besides training to farmers.


Department of Agricultural Cooperation
Directorate of Marketing and Inspection (DMI)
National Institute of Agriculture (NIAM)

The Directorate of Marketing and Inspection (DMI) have prioritised about 670 Wholesale Markets and 40 State Agricultural Marketing Boards and Directorates to implement AGMARKNET Scheme. Node 4 is the state AGMARKNET code for Arunachal Pradesh. The agriculture wholesale market identified by DMI for Arunacha Pradesh is the Naharlagun market of Papumpare district.

Under the IX Plan Scheme, an out lay of Rs 9.95 cores has been approved to establish a Nation-wide "Agriculture Information System Network" (AGRISNET) in collaboration with NIC. AGRISNET proposes to develop (i) the state-of-the-art IT infrastructure requirement to establishment AGRISNET as the INTRANET over NICNET, (ii) development of database and information system for decision support for evaluation, (iii) human resource development, (iv) multi-media based training and demonstration of transfer of technology to strengthen farm research and Education, (v) special interest groups in respect of subject, problems, schemes, etc, and to make the Indian Agriculture on-line for INTERNET and INTRANET.

NHB has implemented a scheme since 1988 with 33 Market Information Centres located all over the country in State Capitals and wholesale markets called the NHBNET (AGMARKNET). These market information centres collect information on prices and arrivals on fruit and vegetables on a daily basis and transmit to the co-ordinating cell for compiling a national bulletin. The market information centre also supplies daily bulletins to Government organisations, co-operative societies engaged in fruit and vegetable trade, Market Committees, State Horticulture and Marketing Departments.


Directorate of Marketing & Inspection
Agricultural Produce Markets
Tradenic online
Department of Agriculture & Cooperation
Department of Animal Husbandry, Dairying & Fisheries
AGMARKNET Portal
State Agricultural Departments
Department of Consumer Affairs
State Agricultural Marketing Boards
Ministry of Commerce & Industry
Department of Food Processing Industries
State Agricultural Directorate of Marketing

Network linkages of Agencies with AGMARKNET

The current market infrastructure, information dissemination on market intelligence in the state is limited. The Directorate of Horticulture has been emphasising for boosting the production of horticultural crops and bring new area under cultivation. Therefore much stress has not been given to development of market information network. At present the information is being disseminated through radios, newspaper, blackboards and public address system at wholesale yards. Where the information is limited and would not be of much help to farmers, as they are not able to know about prevailing prices in other markets, effecting the decision in marketing of their produces. The farmers thus have limited options and left with no opportunity other than selling the produce at uneconomic prices. Keeping the above constrains into account, the

	Hawai-Walong	1	Walong H.Q.		
Changlang	Changlang	3	Changlang H.Q & Nampong H.Q.	Jairampur	
	Khagam (Miao)	16	Vijoynagar H Q.	Namchik	Tue & Sat
				Kharsang Tinali, Songkidong, Longri, Namphai bazar, Namphianong, Kharsang bazar	Saturday
				New Champo, Bordumsa	Monday
				Maithong Pay, New Yumchum, Miao Singpho, T.R.Camp, Miao H.Q.	Mon & Fri.
				Diyun H.Q.	Thur & Sun
Tirap	Namsang	2	Deomali & Laju H.Q.		
	Pangcho Wakka	2	Pancho H.Q & Wakka H.Q.		
	Longding	3	Tissa Camp Longding H.Q & Kanubari H.Q.		

Source: District Census Handbook, 1991

Market Infrastructure

Market infrastructure in the state is under developed compared to the rest of the markets in the country. The facilities available are usually a shed for trading and storage with no scientific handling techniques. Fruit collection centres are located at Tawang, Bomdila, Seppa, Zero, Daporijo, Yingkiong, Passighat, Anini, Tezu, Changlang, Khonsa and Nagarlagun. The only cold storage facilities of 500 MT capacity is located at Bhalukpong and is a government venture. The facility is located at a distance of 30 km from Tezpur and 180 km from Guwahati. (*Refer to Map Plate on infrastructure for horti & Agri in AP*)

Horticulture Market Analysis

Horticulture sector in Arunachal Pradesh has registered a significant growth in recent years .Out of the major horticultural crops produced in Arunachal, the state could boast of large production of fruits like apple, orange, pineapple and banana besides other fruits and spices. Lack of infrastructures like proper marketing outlets and fruit preservation centres in the state has hindered the development of the horticulture sector. Despite the sector's huge potentiality, the state has failed to attract national and international market due to the inadequate infrastructures.

The market assessment survey for fresh and processed fruit products has helped in identifying areas of procurement, products and help identify competitors (National & international), seasonal availability, sale volume, customers preferences, sale prices, markets (infrastructure, access to market, type of market) and means of marketing at the Regional and State level. Findings from the market survey would help in determining the price of commodities, undertake promotion of preferred products, bring about market driven processing technologies. The identified feedback would be taken as a base for selecting the suitable varieties for area expansion, identify demands and gaps in the local markets for strengthening focused species and simultaneously develop marketing network for development of the horticulture sector. Lack of standardization and grading / post harvest in the local products has been noticed, which is a prerequisite for fetching higher prices and compete nationally and internationally. Lack of infrastructure is a major problem that the retailer and wholesaler are facing, incurring a loss of 10-15% or even up to 25-30% in some cases. Inferences from the market survey executed at primary and secondary market are summarised under specific heads.

alysis and Interpretation for fresh Fruits

Apple

Source of Procurement

Apples mostly available at the primary retail market of Arunachal are of the local variety procured from Rupa, Dirang, and other apple growing areas. About 33% available in the local markets represents the national varieties and are procured from Rangapara in Assam or from other places outside the State, while about 16% are imported varieties. In the secondary wholesale market, nearly 78% are of national varieties area procured from Delhi, Simla, Kashmir and Himachal while 22 % are of imported varieties procured through Delhi.

Table14.2 Varieties according to source of procurement

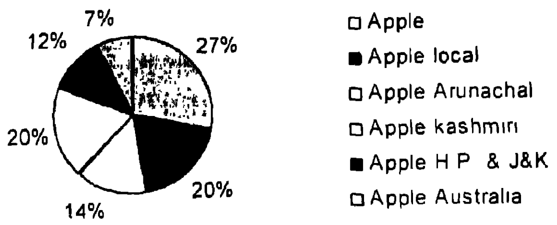
Market	Local, varieties %	National varieties %	Imported varieties %
Primary Retail	50	33.33	16.67
Secondary Retail	0	40	60
Secondary Wholesale	0	77 78	22.22

Seasonal Availability

In the Primary retail market the local varieties are available only during the months of October and February while the national and the imported varieties are available throughout the year. In the Secondary Wholesale market the varieties procured from Delhi (Delhi size and Kinnor) are available throughout the year while the imported varieties (American and New Zealand) procured from Delhi are available between June and August. The varieties from Kashmir (Raja and Maharaja) are available in the month of August to September. Shimal varieties (Royal Misri) are available during the month of July and those from Himachal Pradesh (Delicious royal and Red Gold) Between August to November.

Sale volume

Annual sale volume of different varieties of apple in Primary retail market



More than half of the total apples sold at the primary retail market are the local varieties, about 19% are of the Kashmiri variety, 12% are of H.P.& J&K variety and about 7% are of the Australia variety.

Table 14.3: Secondary wholesale market

Variety*	**Sale volume per year (in %)**
Apple-Delicious royal	22.22
Apple -Royal Misri	11 11
Apple -RedGold	44 44
Apple Maharaja	22.22

**The annual sale volumes of all the varieties are not available*

Among the varieties whose sale volume could be predicted in the Secondary wholesale market, the RedGold variety has the maximum annual sale volume at about 45% followed by Delicious royal and Maharaja at 22% each and Royal mishri at 11%.

Table 14.4: Daily Sale Volume per fruit seller

Primary Retail market	
Variety	Sale volume per day(in Kg)
Apple	17.5
Apple local	12.5
Apple Arunachal	3

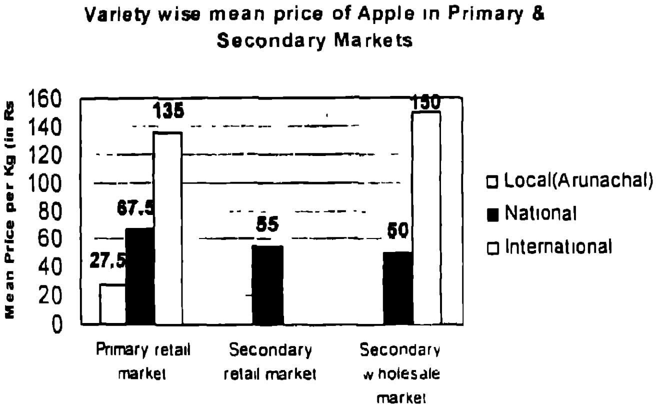
Apple (National varieties)	2
Apple (International var)	1
Secondary Retail market	
Apple (all varieties)	25
Secondary Wholesale market	
Apple (National varieties)	750
Apple (International varieties)	NA

The average sale volume of the local Apples in the Primary retail market is about 15 Kg per day while that of Apple Arunachal is 3 Kg per day. The average sale volume for the national varieties is 2- 3 Kg per day and for the international varieties it is about 1 Kg per day. In the Secondary retail market the average sale volumes for all the varieties are about 25 Kg per day and in the secondary wholesale market it is about 750 Kg per day.

Table 14.5: Selling Price

	Price per Kg (in Rupees)		
Variety	Primary retail market	Secondary retail market	Secondary wholesale market
Local(Arunachal)	27.5	-	-
National	67.5	55	50
International	135	-	150

Mean Market Price



In the Primary retail market, the average selling price for the local varieties is about Rupees 27/- per Kg (the Local is about Rs 15-20/- and the Arunachal variety is about Rs 35-40/- per Kg), that of the national varieties are between Rs 60-80/- per Kg while that of the international variety is Rs 120-150/- per Kg. In the Secondary retail market the selling prices of all the national varieties are Rs 55/- per Kg. In the Secondary wholesale market the average selling price for all the National varieties is Rs 50/- per Kg while that of the International variety is Rs 150/- per Kg.

Type of Packing

Three types of packages are used for packing the apples in all the markets: Wooden Box, Paper Carton and Jute bag. The local varieties are mostly packed in Jute bags, the national varieties in wooden boxes and the imported varieties in paper cartons. The capacity of the boxes and the cartons are generally 10 Kg each.

Grading

In the Primary retail market, most of the varieties of Apples are not graded. Only the Kashmiri, Australia and one of the local varieties are graded. In the secondary retail and wholesale markets all the varieties are graded as per quality.

Spoilage

In the Primary and Secondary retail markets, 10-15% of the fruits (Apple) get spoiled while in the Secondary wholesale market, 8-10% gets spoiled.

Shelf life period

In the Primary retail market shelf life period of Apples is between 30-45 days for all the varieties.

In the secondary retail and wholesale markets the shelf life period is 3-4 days. While if stored at the cold storage the period goes up to 1-2 weeks.

Conclusion

More than 50% of the apples available in the primary retail market are of the local variety but they are available only for a certain period of the year unlike some national and international varieties available throughout the year. Moreover the local varieties are sold at quite cheap rates compared to the ones coming from outside and they are not graded. In the secondary market the Red Gold variety appears to have the maximum demand. There is high spoilage rate in all the markets mainly due to lack of proper storage facility and good transport system.

Orange

Source of Procurement

Of the three varieties of oranges available in the Primary retail market of Arunachal Pradesh, two (Orange1 & Orange Along) are of the local variety procured from the local market or from Along. One variety (Orange2) is procured from Rangapara in Assam.

In the secondary wholesale market (at Guwahati), Orange Arunachal is procured from Arunachal Pradesh, Orange Bhutan from Bhutan, Orange Nagpur from outside the NE region while Orange Assam from Assam. In the secondary retail market of Guwahati all the oranges are procured from the wholesale market of Fancy Bazar.

Table 14.6: Seasonal Availability

Market	Variety	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary Retail	Orange 1	x	x										x
	Orange2	x	x										
	Orange Along/Daporijo	x	x	x								x	x
Secondary Wholesale	OrangeAP						x	x					
	OrangeBhutan	x	x									x	x
	OrangeNagpur				x	x							
	OrangeAssam	x	x									x	x

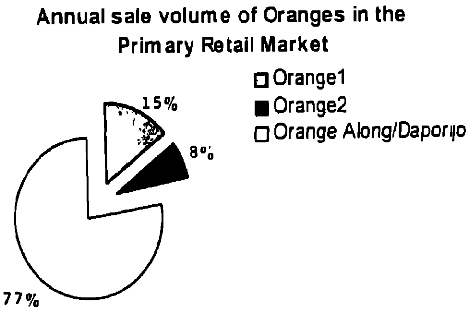
In the Primary retail market the varieties orange1 & Orange2 are available only between the months of December and February while Orange Along is available from November to March. In the Secondary Wholesale market the variety Orange Arunachal Pradesh (AP) is available in the months of June and July while Orange Nagpur is available during April-May. Orange Bhutan and Orange Assam are available from Nov-Feb.

Sale Volume

Annual Sale Volume

Table 14.7: Primary Retail market

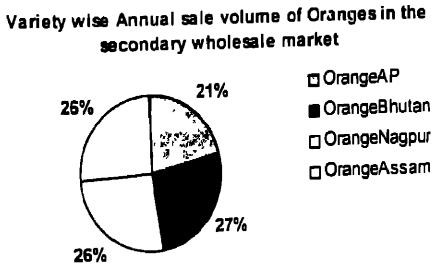
Variety	Sale volume per year (in%)
Orange1	14.56
Orange2	7.77
Orange Along/Daporijo	77.67



More than 75% of the oranges sold in the Primary retail market belong to the Along/Daporijo variety, about 15% are of the Orange 1 variety are procured from the local market and only about 7% are of the Orange 2 variety got from Rangapara.

Table 14.8: Secondary wholesale market

Variety	Sale volume per year(in %)
OrangeAP	21.05
OrangeBhutan	26.32
OrangeNagpur	26.32
OrangeAssam	26.32



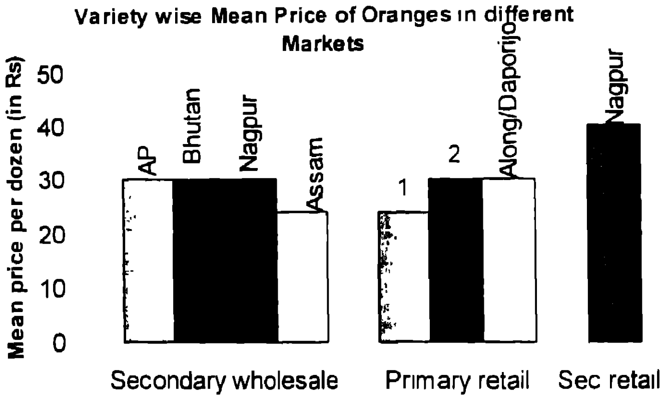
All the varieties of Oranges in the Secondary wholesale market have almost equivalent annual sale volume.

Table 14.9: Daily Sale Volume per fruit seller

Primary Retail market	
Variety	Sale volume per day
Orange1	250 Pieces
Orange2	200 Pieces
Orange Along/Daporijo	850 Pieces
Secondary Wholesale market	
OrangeAP	3-5 tons
OrangeBhutan	4-6 tons
OrangeNagpur	5-6 tons
OrangeAssam	4-6 tons

The average sale volume per fruit seller in the Primary retail market is about 850 pieces per day while that of the other 2 varieties are 200-250. In the secondary wholesale market each variety's sale volume is about 3-6 tons per day.

Selling Price



In the Primary retail market, the average selling price for the variety 1 (procured from the local market) which is Rs 24/- per dozen is less than the variety 2 (procured from Rangapara) and variety Along which are Rs 30/- per dozen. While in the Secondary wholesale market the average selling price for all the surveyed varieties is about Rs 30/- per dozen except the Assam variety, which is about Rs 24/- per dozen. The selling price of only the Nagpur variety is available in the Secondary retail market which is about Rs 40/- per dozen.

Type of Packing

Wooden Boxes are used mostly for packaging Oranges in all the markets. In the Primary retail market the local varieties are packed in Jute bags or Bamboo baskets. The capacity of a box is generally 10 Kg.

Grading

The varieties of Oranges available in the Primary retail market are not graded but in the secondary retail and wholesale market all the varieties are graded as per quality.

Spoilage

In the Primary retail market, the spoilage rate is 10-15% for Orange 1 & 2 varieties and 22-25% for the Along variety. High spoilage rate for the Along variety could be due to its packaging in Bamboo baskets or lack of good transport system. In the Secondary wholesale market, spoilage rate is very less.

Shelf life period

In the Primary retail market shelf life period of Oranges is between 10-15 days. In the Secondary wholesale market the shelf life period is 5 days to 1 week while in the Secondary retail market it is about 3 days. The larger varieties (Nagpur & Bhutan) have lesser shelf life period.

Conclusion

The varieties of Oranges from Arunachal Pradesh have good demand -more than 75% in the primary market and more than 20% in the secondary market, especially the Along variety. They even fetch good market price and are at par with the national (Nagpur) and international (Bhutan) varieties. But there is high spoilage rate, mainly due to its packaging in Bamboo baskets and lack of good transport system

Pears

Source of Procurement

In the Primary retail market of Arunachal Pears are procured from the local market itself while in the secondary wholesale market, they are procured from Amritsar.

Table 14.10: Seasonal Availability

Market	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary retail									x	x	x	
Secondary Wholesale						x	x					

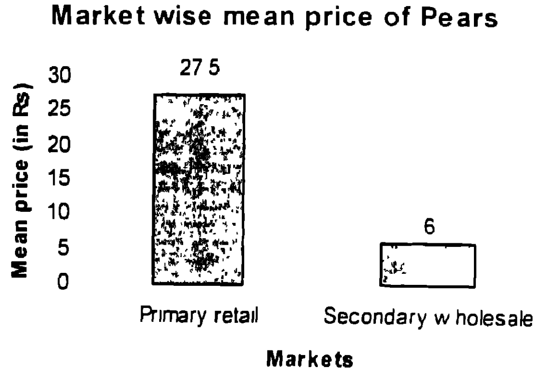
In the Primary retail market Pears are available between the months of September and November while in the Secondary Wholesale market they are available only in the months of June and July.

Table 14.11: Sale Volume

Market	Sale volume per day (in Kg)
Primary retail	25-30
Secondary wholesale	800- 10,000

The average daily sale volume of Pears in the Primary retail market is about 25-30 Kg per fruit seller while that in the Secondary wholesale market is 800-10,000 per fruit seller.

Selling Price



The average selling price for Pears in the Primary retail market is about Rupees 27.5/- per Kg while the price in the Secondary wholesale market Rs 6/- per Kg.

Type of Packing

Jute bags are used for packaging pears in the Primary retail market whereas wooden boxes are used in the Secondary wholesale market.

Grading

The pears in the Primary retail market are not graded whereas the ones in the Secondary wholesale markets are graded.

Spoilage

In the Primary retail markets, 8-10% of the fruits (Pears) get spoiled while in the Secondary wholesale market, 5% gets spoiled.

Conclusion

Pears are procured from the local market in Primary retail market and from outside the NE region for the secondary market. Moreover the seasonal availability of pears is different for the primary and secondary markets. So production in other seasons could be experimented. However, the selling price of pears in the primary market is quite high compared to that in the secondary market.

Pomegranate

Source of Procurement

Pomegranates sold in the Primary retail market of Arunachal are procured from outside the State while in the secondary wholesale market, they are procured from Maharashtra.

Table 14.12: Seasonal Availability

Market	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary retail	x	x	x	x	x	x	x	x	x	x	x	x
Secondary wholesale	x	x	x					x	x	x	x	x

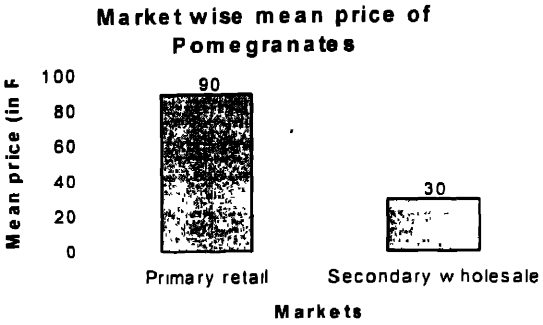
In the Primary retail market Pomegranates are available throughout the year whereas in the Secondary Wholesale market they are available from August to March.

Table 14.13: Sale Volume per fruit seller

Market	Sale volume per day (in Kg)
Primary retail	2-3
Secondary wholesale	7-8

The average daily sale volume of Pomegranates in the Primary retail market is about 2-3 Kg per fruit seller while that in the Secondary wholesale market is 7-8 Kg per fruit seller.

Selling Price



The average selling price for Pomegranates in the Primary retail market is about Rupees 90/- per Kg while the price in the Secondary wholesale market Rs 30/- per Kg.

Type of Packing

Paper Cartons are used for packaging Pomegranates in the Primary retail market as well as in the Secondary wholesale market.

Grading

The Pomegranates in the Primary retail market as well as in the Secondary wholesale market are graded.

Spoilage

In the Primary retail market 5-10% of the fruits (Pomegranates) get spoiled while in the Secondary wholesale market, about 5% get spoiled.

Shelf life period

In the Primary retail market shelf life period of Pomegranates is between 30-60 days.

Conclusion

Pomegranates are procured from outside Northeast for all the markets and are available almost throughout the year. As the fruit is procured from outside the state, the selling price is high, especially in the Primary retail market.

Mousambi

Source of Procurement

The variety of Mousambi available in the Primary retail market of Arunachal Pradesh, comes from outside the state. In the secondary wholesale market, Mousombi Andhra comes from Andhra Pradesh, Mousombi Nagpur from Nagpur, Mousombi Large and Mousumbi Small from Lucknow. In the secondary retail market of Guwahati all the varieties (Calcutta, Madras & Nasik) are procured from the wholesale market of Fancy Bazar.

Seasonal Availability

In the Primary retail market mousambis are available between the months of October and May while in the Secondary Wholesale market and Secondary retail market, all the varieties are available throughout the year.

Table 14.14:

Market	Variety	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary retail	Mousambi	x	x	x	x	x					x	x	x
Secondary retail	Calcutta	x	x	x	x	x	x	x	x	x	x	x	x
	Madras	x	x	x	x	x	x	x	x	x	x	x	x
	Nasik	x	x	x	x	x	x	x	x	x	x	x	x
Secondary wholesale	Andhra	x	x	x	x	x	x	x	x	x	x	x	x
	Nagpur	x	x	x	x	x	x	x	x	x	x	x	x
	Large	x	x	x	x	x	x	x	x	x	x	x	x
	small	x	x	x	x	x	x	x	x	x	x	x	x

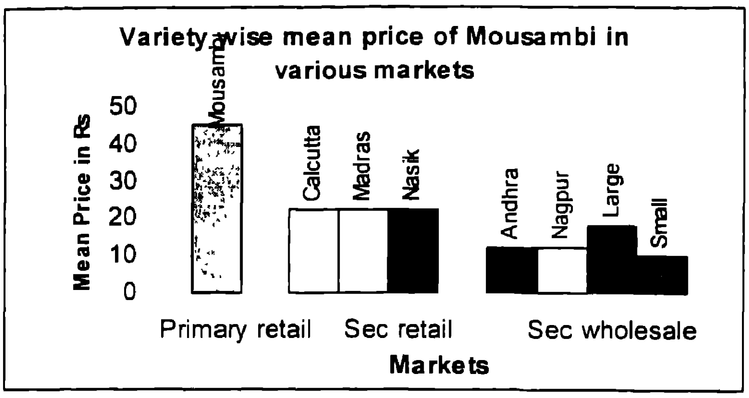
Table 14.15: Daily Sale Volume

Variety	Sale volume per day(in Kg) per fruit seller
Primary Retail market	
Mousambi	2-3
Secondary retail	
Mousambi Calcutta	3
Mousambi Madras	3
Mousambi Nasik	3
Secondary wholesale	
Mousombi Andhra	20
Mousombi Nagpur	NA
Mousombi Large	20-25
Mousumbi small	20-25

The average sale volume of Mousambi in the Primary retail market is about 2-3 Kg/day per fruit seller. In the Secondary retail market the average sale volumes for all the varieties are about 3 Kg/day and in the secondary wholesale market Mousambi

(Andhra's) sale volume is about 20 Kg/day, while Mousamb, which are large and small, the sale volume are 20-25 Kg/day per fruit seller.

Selling Price



The average selling price for Mousambi in the Primary retail market is Rs 45/- per Kg. In the Secondary retail market the average selling prices of all the varieties are Rs 22.5/- per Kg. In the Secondary wholesale market the average selling price for Andhra and Nagpur variety are 12.5 per Kg while that of the large variety is Rs 18/- per Kg and that of the Small variety is Rs. 10 per Kg.

Type of Packing

In the Primary market, mousambis are usually packed in Bamboo baskets, while in the secondary retail and wholesale markets sacks and gunny bags are used.

Grading

In all the markets Mousambis are graded as per size.

Spoilage

In the Primary and Secondary retail markets, 5-10% of the fruits (Mousambis) get spoiled while in the Secondary wholesale market, the rate of spoilage is negligible.

Shelf life period

In the Primary retail market, shelf life period of Mousambis is between 30-60 days. In the secondary retail market it is 2-3 days and in the wholesale markets the shelf life period is 5-7 days.

Conclusion

Though Mousambis has a demand almost throughout the year in the region, they are all procured from outside North-east India. The spoilage rate is quite less from all the varieties compared to other fruits except in the primary retail market where there is no storage facility. Potential for popularisation of Mousambi in Arunachal Pradesh could be ideal.

Plum

Source of Procurement

In the Primary retail market of Arunachal Pradesh plums are procured from outside the State while in the secondary wholesale market, they are procured from Shillong.

Table 14.16: Seasonal Availability

Market	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary						x	x	x	x			
Sec					x	x						

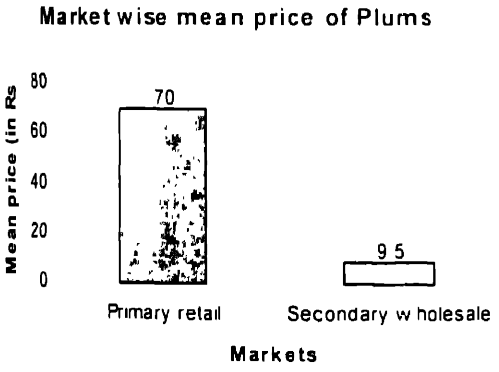
In the Primary retail market plums are available in the months of June to September while in the Secondary Wholesale market they are available only in the months of May and June.

Table 14.18: Sale Volume

Market	Sale volume per day (in Kg)
Primary retail	2-3 Kg
Secondary wholesale	Not much

The average daily sale volume of Plums in the Primary retail market is about 2-3 Kg per day per fruit seller while that in the Secondary wholesale market is not available in detail but is not much.

Selling Price



There is a remarkable difference in the mean price of lums in the primary retail and secondary wholesale market. The average selling price for Plums in the Primary retail market is about Rupees 70/- per Kg while the price in the Secondary wholesale market is about Rs 9.5/- per Kg.

Type of Packing

Bamboo baskets are used for packaging plums in the Primary retail market whereas wooden boxes are used in the Secondary wholesale market.

Grading

The plums in the Primary retail market as well as the ones in the Secondary wholesale markets are graded as per variety and size.

Spoilage

In the Primary retail markets, 15-20% Plums gets spoiled while in the Secondary wholesale market, spoilage is very minute. The high spoilage rate could be because of the packaging as well as lack of proper storage facility.

Conclusion

Plums are procured outside the state for Arunachal primary market while they come from Shillong in the secondary market. They are available only for a short season and their demand is less in the secondary market. Market price is very high in the primary market and spoilage rate is also very high.

Mango

Source of Procurement

In the Primary market, Mango1 is procured from NLP, Mango2 from Rangapara and Mango 3 from outside the state. In the secondary wholesale market all the varieties are obtained from the Secondary wholesale market. Lengera and Gulapkhas are procured from Andhra Pradesh, Dosori from Bengal, Sosa and Biwi from Uttar Pradesh and Maldoi from Malda.

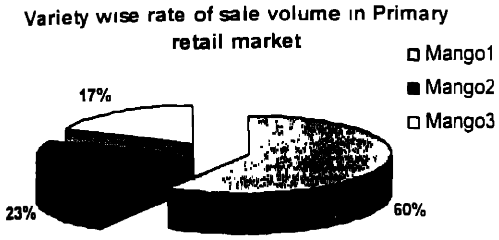
Table 14.19: Seasonal Availability

Market	Variety	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary retail	Mango 1					x	x	x					
	Mango2					x	x						
	Mango3					x	x	x	x				
Secondary retail	All				x	x	x	x					
Secondary wholesale	Lengera				x	x							
	Dosori					x	x	x					
	Sosa					x	x	x					
	Maldoi					x	x	x					
	Gulapkhas					x	x	x					
	Biwi					x	x	x					

Most of the varieties of mangoes are available in the months of May to July in all the markets. A few varieties like the Lengera comes early from April and a few varieties like mango 3 in the Primary retail market stays till September.

Annual Sale Volume

Primary Retail market



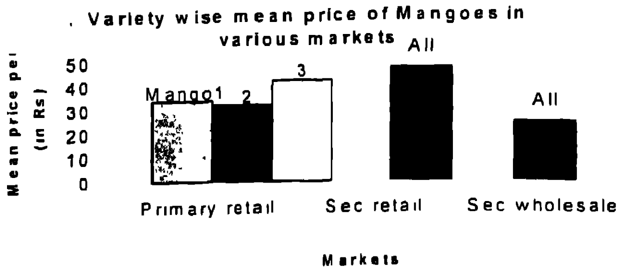
60% the mangoes sold in the Primary retail market is the variety 1 procured from NLP, about 23% are of variety 2 procured from Rongapara while about 17% are of variety 3 procured from outside the State. In the Secondary retail and wholesale markets all the varieties have equal sale volumes.

Table 14.20: Daily Sale Volume

Primary Retail market	
Variety	Sale volume per day(in Kg)
Mango1	10-25
Mango2	5-15
Mango3	2.5-3.5
Secondary Retail market	
Mango (all varieties)	3-5
Secondary Wholesale market	
Mango (all varieties)	5000

The average sale volume of Mangoes per fruit seller in the Primary retail market is about 17.5 Kg/day for variety 1 while that of variety 2 is 10 Kg/day and that of variety 3 is about 3 Kg/day. In the Secondary retail market the average sale volumes for all the varieties are about 4 Kg/day and in the secondary wholesale market it is about 5000 Kg/day per fruit seller.

Selling Price



In the primary retail market, the average selling price for variety 1 is Rupees 18-50/- per Kg , variety 2 is Rs 15- 50/- per Kg and variety 3 is Rs 40-55/- per Kg. In the Secondary retail market the rates are Rs 40-55/- per Kg and in the Secondary wholesale market they are Rs 20-30/- per Kg for all the varieties.

Type of Packing

Wooden Boxes and paper cartons are mostly used for packaging mangoes in all the markets. The capacity of the boxes and the cartons are generally 10 Kg each.

Grading

All the varieties are graded in all the markets.

Spoilage

In the Primary retail market, the spoilage rate for the varieties packed in wooden boxes is 10-12%, while for the ones packed in Bamboo baskets the spoilage rate is 20-30%. In the Secondary wholesale market the spoilage rate is 10-15% for the varieties packed in wooden boxes whereas 9-10% for the varieties packed in paper cartons.

Shelf life period

In the Primary retail market shelf life period of mangoes is 30-40 days for all the varieties.

Conclusion

All the varieties of mangoes available in the markets are from outside the NE region. Though the varieties are available only for a short period of the season, their demand seen to be high. The NLP variety has high demand in the Primary market.

Analysis and Interpretation for processed Products

Fruits can be preserved for a longer period of time through value addition techniques making it available in all seasons. A wide variety of processed fruit products are available in the primary (Arunachal) market as well as in the secondary (Guwahati) Market. These products have been classified into: Pickles, Jam & Jelly, Juices and Squash and Dry fruits and Confectionaries.

Pickles

Pickles are made by marinating fruits and vegetables in oil, salt etc. The most popular brands existing in the market are Weikfield, Mother's Recipe, Goldiee, Priya, Nilon's, Maggie, Tipsy's, Sona, Royal Bhutan, Druk and Niru. Most of these companies are based outside the Northeastern region, mainly in Gujarat, Hyderabad, U.P. Uttaranchal and Chandigarh. Some products also come from Bhutan and Assam. Mixed pickle made from a number of fruits/ vegetables appears to be the most favoured product followed by mango, chilli, lime etc. The packaging for pickles is mostly done in sealed glass bottles or sealed plastic bottles and the capacity of these containers range from 100 gms to 5 Kgs. The average price range is Rs 25/- for 200 gms, Rs 35- 40/- for 400 gms, and Rs 55/- for 1 Kg. The table 14.21 A, provides a detail information of processed food products in the region and provides an insight to the possible opportunities.

Table 14.21.A information of processed food products

Brand	Item	Company	Price
Weikfield	Sweet Mango Chutney	Weikfield Agri products Ltd. Pune-412207	Rs 31/- 250 gms
Mother's Recipe	Gujarati Gorkeri pickle	ADF Foods Ltd. Gujarat	Rs 55/- 575 gms
Mother's Recipe	Mango Pickle	ADF Foods Ltd. Gujarat	Rs 50/- 500 gms
Mother's Recipe	Punjabi Panhranga Achar	ADF Foods Ltd. Gujarat	Rs 50/- 500 gms
Goldiee	Mango Pickle	Manav Gramodyog Mandal. Kanpur	
Goldiee	Mixed Pickle (lemon,dela,fruit,mango)	Manav Gramodyog Mandal. Kanpur	Rs 40/- 400 gms
Nilon's	Five Star Mixed Pickle	Nilon's Enterprise Pvt. Ltd. Uttran	Rs 55/- , 1 kg
Priya	Sweet Mango Chutney (sliced)	Eenodu Complex Somajigudd Hyderabad	Rs 35/-. 340 gms
Priya	Mixed Fruit Pickle	Eenodu Complex Somajigudd Hyderabad	Rs 51/- ,500 gms
Maggi	Mango Teekha	Nestle Consumer Services, N. Delhi	Rs 42/- 400 gms
Nilon's	Mango Pickle	Nilon's Enterprise Pvt.Ltd. Uttran	Rs 24/- , 200 gm
Mother's Recipe	Mixed Pickle		Rs 34/- , 300 gm
Tipsy's	Mango Pickle	ADF Food Ltd., Gujarat	Rs 26/- 100 gm
Sona	Mango Pickle	Soda Spices Ltd.Chandigarh	Rs 27/- , 200 gm
Royal Bhutan	Mango Pickle(in oil)	Himland Agro Food Ltd.H.P	Rs 38/- , 400 gm

Druk	Mixed Pickle	Bhutan Agro Industries (Govt of Bhutan)	Rs 40/- 400 gm
Niru	Mixed Pickle (Mango)	Modern Food processing Co-operative society Ltd, Guwahati	Rs 40/-, 400 gms
Primary Market			
Mohan Daries	Mixed Pickle	Mohan Daries Ltd., U.P.	Rs 40/- 400 gm
Mohan Daries	Mixed Pickle(small)	Mohan Daries Ltd., U.P.	Rs 24/- 200 gm
Mohan Daries	Lime Pickle	Mohan Daries Ltd., U.P.	Rs 38/-, 400 gm
	Chilli Pickle	Mohan Daries Ltd., U.P.	Rs 25.50/-, 200 gm
Nilon's	Mixed Pickle	Nilon's Enterprise Pvt.Ltd., Utran	Rs 165, 5 kg
Nilon's	Mixed Pickle	Nilon's Enterprise Pvt.Ltd, Utran	Rs 55/-, 1 kg
Nilon's	Mixed Pickle	Nilon's Enterprise Pvt.Ltd., Utran	Rs 42, 400 gm
Nilon's	Mixed Pickle	Nilon's Enterprise Pvt.Ltd., Utran	Rs 24/-, 200 gm
Nilon's	Green Chilly	Nilon's Enterprise Pvt.Ltd., Utran	Rs 42, 400 gm
Nilon's	Green Chilly	Nilon's Enterprise Pvt.Ltd, Utran	Rs 24/-, 200 gm
Nilon's	Mango	Nilon's Enterprise Pvt.Ltd., Utran	Rs 42, 400 gm
Nilon's	Mango	Nilon's Enterprise Pvt.Ltd., Utran	Rs 24/-, 200 gm
Priya	Mixed Pickle	Ushodaya Enterprise Ltd., Hyderabad	Rs 34/- 400 gm
Priya	Mango	Ushodaya Enterprise Ltd., Hyderabad	Rs 34/- 400 gm
Priya	Garlic	Ushodaya Enterprise Ltd., Hyderabad	Rs 34/- 400 gm

Jam & jelly

Jams and Jellies are fruit preserves made by boiling fruit pulp/ juice with sugar and pectin until a semi-solid consistency is reached. The popular brands of jams and jellies existing in the market are Kissan, Sil, Sera, Virendra and Fox's crystal clear. All these companies are based outside the region, mainly in Mumbai, Pune, Hyderabad, West Bengal and Indonesia. Mixed fruit jams and jellies are in most demand; others are made from Pineapple, mango, cherry etc. The packaging provided for jams and jellies is mostly in sealed glass bottles and in sealed tins. The capacity of these containers ranges from 25 gms to 500 gms. The average price range is Rs 20-25/- for 200 gms and Rs 50/- for 500 gms. The imported variety preserved fruits cost about Rs 80/- for 200 gms. Table B, provides a detail analysis on jam and jelly.

Table 14.21.B

Brand	Item	Company	Price
Kissan	Mixed Fruit Jam	Hindustan Lever Ltd. Mumbai	Rs 51/- 500 gm
Kissan	Fruit Kick Jam	Hindustan Lever Ltd. Mumbai	Rs 53/-, 500 gm
Sil	Mixed Fruit Jam	Marico Industries Ltd. Mumbai	Rs 52/-, 500 gm
Sil	Plentee Pineapple	Marico Industries Ltd Mumbai	Rs 53/- 500 gm
Kissan	Fruit Kick Jam	Hindustan Lever Ltd. Mumbai	Rs 12/- 100 gm
Kissan	Mixed Fruit Jam	Hindustan Lever Ltd. Mumbai	Rs 53/- 500 gm
Virendra	Cherry Rich	Raj Unisu Foods Ltd. Hyderabad	Rs 5/- 25 gms
Sil	Mixed Fruit Jam (small)	Khalad Village Pune	Rs 31/-, 270 gms
	Mixed Fruit Jam	Khalad Village Pune	Rs 52/-, 500 gms

Kissan	Pineapple Jam	Hindustan Lever Ltd. Mumbai	Rs 50/- 500 gm
Kissan	Mango Jam	Hindustan Lever Ltd. Mumbai	Rs 25/- 200 gm
Sera	Mixed Fruit Jam	Legend Food Industries, West Bengal	Rs 42/- 500 gm
	New Fruitips	Nestle India Ltd. , India	Rs 50/- 350 gms
Fox's	Crystal Clear Fruits	P.T.Nestle Confectionery Indonesia	Rs 30/- , 100 gms
Fox's crystal clear	Tropical Fruits	P.T.Nestle Confectionery Indonesia	Rs 80/-, 200 gms
Fox's crystal clear	Black Currant	P.T.Nestle Confectionery Indonesia	Rs 80/- , 200 gms
Fox's crystal clear	Fruits	P.T.Nestle Confectionery Indonesia	Rs 80/- , 200 gms
Kissan	Fruit Kick Jam	Hindustan Lever Ltd.,Mumbai-400020	Rs 52/-,500 gm
Kissan	Mango fruit Kick Jam	Hindustan Lever Ltd.,Mumbai-400020	Rs 53/-, 500 gm

Juices & Squash

Juice is the extractable liquid of fruits and vegetables used for drinking. Fruit juice is the most common among processed fruit products. A multitude of brands are available in the market, the most popular are Real, Mohun. Harvey, Sera, Rasna, Kissan, Druk, Eva, Rallie's Morton, Haldiram etc. These companies are based parts of India, mainly in New Delhi, Ahmedabad, West Bengaland Kashmir. Many imported products are available in the market from Australia, Nepal, Bhutan, Indonesia etc. Some local products from Assam and Meghalaya are also available in the market. A wide variety of fruits are used to make juices, like pineapple, orange, mango, grapes, apple, guava etc. The packaging for juices is mostly done in sealed glass bottles, plastic bottles, tins and Tetra packs. The capacity of these containers range from 200 ml to 1 litre. The average price range is Rs 20/- for 200 ml, Rs 70/- for 1 litre. The imported varieties are priced at about Rs 100- 200/- per litre. (Table C)

Table 14.21.C

Brand	Item	Company	Price
Real Fruit Juices	Pineapple	Dabur Foods Ltd., New Delhi	Rs 62.00 1 Litre
	Grape	Dabur Foods Ltd., New Delhi	Rs 75.00/- 1 Litre
	Active Apple	Dabur Foods Ltd., New Delhi	Rs 68.00/- 1Litre
	Mango Nectar	Dabur Foods Ltd., New Delhi	Rs 62.00/- 1 Litre
	Guava Nectar	Dabur Foods Ltd., New Delhi	Rs 68.00/- 1 Litre
	Mized Fruit	Dabur Foods Ltd., New Delhi	Rs 68.00/- 1 Litre
Harvey Fresh Juice	Tropicana Juice	Harvey Fresh, Australia	Rs 105/- , 1 Litre
	Orange Juice	Harvey Fresh, Australia	Rs 105/- , 1 Litre
	Apple Juice	Harvey Fresh, Australia	Rs 105/- , 1 Litre
	Orange & Mango Juice	Harvey Fresh, Australia	Rs 105/- , 1 Litre
Mohun's Goldcoin	Apple Juice	Mohan Mention Ltd. (U.P)	Rs 15.50/-, 200 ml
Eva Juices	Pineapple	E.Eva, Spain	Rs 220/- , 1 Litre
	Apple	E.Eva, Spain	Rs 220/- , 1 Litre

	Peach	E.Eva, Spain	Rs 220/- , 1 Litre
	Grape	E.Eva, Spain	Rs 220/- , 1 Litre
Druk	Mango Juice (sweetened)	Bhutan Agro Industries, Bhutan	Rs 48/- , 800 ml
	Pineapple Juice (sweetened)	Bhutan Agro Industries, Bhutan	Rs 48/- , 800 ml
Rasna	Rozana Rasna Orange	Rasna Ltd. Ahmedabad , India	Rs 28/-, 200 ml
Instant Rasna	Orange	Status Enterprise, Ahmedabad	Rs 107.00/- 500 gms
	Mango	Status Enterprise, Ahmedabad	Rs 107.00/- 500 gm
Utsav Rasna	Orange	Pioma Industries, Ahmedabad	Rs 28.50/-
	Pineaple	Pioma Industries, Ahmedabad	Rs 28.50/-
	Mango	Pioma Industries, Ahmedabad	Rs 28.50/-
Glucon D	Tangy Orange	Heinz Indai Pvt. Ltd., New Delhi	Rs 38/- , 200 gms
Noga	Orange Squash	Maharastra Agro Industries Development Corporation Ltd., Mumbai	Rs 52/-
Kashmir Apiaries	Kashmir Apiaries	Kashmir Apiaries, Kashmir	Rs 62/- 700 ml
Sera	Orange Squash	Legend Food Industries, West Bengal	Rs 51/- 700 ml
Sona	Orange Squash	Sona spices Pvt. Ltd. Chandigarh	Rs 53/- 700 ml
	Orange Squash	Bhutan Agro Industries (a royal govt of Bhutan)	Rs 51/- 700 ml
Kamdhenu	Carambola Squash	Kamdhenu Industry Assam	Rs 40/- , 700 ml
	Peach Halves	Bhutan Agro Industries, Thimphu	Rs 35/- 450 gm
	Lime Juice Cordial	Bhutan Agro Industries, Thimphu	Rs 50/- 700 ml
	Pineaple Slices (in syrup)	Bhutan Agro Industries, Thimphu	Rs 55/- 850 gm
Meghalaya	Pineapple slices (in syrup)	Meghalaya Fruit preservative Factory, Dianadubi	Rs 48/- 850 gms
Kissan Squash	Pineapple(Fruit Kick)	Hindustan Lever Ltd. Mumbai	Rs 54/- 700 ml
Ralli's	Strawberry Syrup	Ralli Singh & Grandsons Pvt. Ltd West Bengal	Rs 70/- , 700 ml
Morton	Fruit Cocktail Syrup	Allahabad Canne's Co , U.P	Rs 37/- , 450 gms
Golden Crown	Fruit Cocktail (in syrup)	Basant Agritech Ranchi	Rs 30/- , 450 gms
Haldiram	Sweet Mango Lachha	Haldiram Bhujiawala ,West Bengal	Rs 53/- , 500 gms
	Orange Squash	ATC Agro Industries Ltd.,Meghalaya	Rs 54/- , 700 ml
	orange Squash(small)	Universal Health Care Products, Karnataka	Rs 29/- 350 ml
	orange Squash(big)	Universal Health Care Products, Karnataka	Rs 52/- , 700 ml
	Lime Juice cordial	Bhutan Fruit Products Ltd., Bhutan	Rs 50/- , 700 ml
	Maaza	Hindustan Coca Cola Beverage Pvt. Ltd., Harayana	Rs 9 200 ml
Kissan	Squash	Hindustan Lever Ltd. Mumbai	
Kissan	Fruit Juice	Allahabad Canning Co Pvt. Ltd., U.P	Rs 20 200 ml

Druk	Frooti	Keventar Agro, West Bengal	Rs 10 ,200 ml
	Real	Dabur, West Bengal	Rs 10 ,200 ml
Kissan	Safal	Kissan, Nagpur	Rs 10 ,200 ml
Morton	Fruit Juice	Real, Nepal	Rs 62/- , 1 ltr

Dry fruits and Confectionaries

Various types of dry fruits like cashew nuts, Hazel nuts, Kishmis, Pista, Chocolate products and confectionaries made from dry fruits are available in the market. These products are processed in New Delhi, Maharashtra and some even come from Malaysia. The packaging for dry fruits is mostly done in poly packs. The average price range varies according to the products. (Table D)

Table14.21. D

Item	Company	Price
Hazel Nutchoco	Vista AllureSoh Malaysia	Rs 150/- ,
Fruit & Nut Choco	Vista AllureSoh Malaysia	Rs 150/- ,
Almond Nut Choco	Vista AllureSoh Malaysia	Rs 150/- ,
Almond nuts	Benus chocolate and candy SDN., Malaysia	Rs 175/- , 200 gms
Cashew nut	Andhra Pradesh, Goa, Maharastra	Rs 360 , kg
Cashew nut	Coco pulse,New Delhi	Rs 500 ,kg
Kismis	Coco pulse,New Delhi	Rs 400 , kg
Pista(salted)	Coco pulse,New Delhi	Rs 440-460/ kg
Kaju Salted Rosted	Coco pulse,New Delhi	Rs 125/- 250 gm
Pista	Coco pulse,New Delhi	Rs 115/- 250 gms
Pista	Coco pulse,New Delhi	Rs 195/- , 500 gm
Chocolate	Cadbury,Mumbai	Rs 10/-
Wafer	chitoos , pepsicoMumbai	Rs 10/-, 30 gm
Wafer	cadbury,chitoos,Mumbai	Rs 10/-

Summary

A variety of processed fruit products are available in the primary and secondary markets. But most of these products are from outside the Northeast region. The possibility of producing such products in the State of Arunachal or in other Northeastern states may be possible if

- Good quality raw materials (fruits) are available locally
- Proper and scientific storage facilities are used in farms as well as in Markets
- Advanced processing techniques are adopted
- Strong advertising of the local products are ensured
- Co-operative bodies are formed to market the products

- Possibility for export are exploited

Market development strategy:

Marketing of fruit crops for Arunachal Pradesh in established markets will be competitive and therefore the product have to be focused in terms of quality and not in terms of quantity. The growers have to source quality-planting material and target the elite buyers who can support a premium price. Besides fruits graded have to be targeted towards specific markets that are local and regional.

Standardising there product through test at the labs

Poor harvesting methods and careless handling, storage, transportation etc, leads to a loss of 25 - 40% of the harvested fruits. Introduction of postharvest management technology (PHT) would help to keep produce safe and healthy, right from field to consumer. Beside the cost of conserving produce is lower than the cost of producing the same quantity. PHT would help in providing a better quality at an economical price, which would yield better consumer response and higher profits, that would provide higher returns from the same harvest, and finally more money flowing back into rural areas. The techniques are Basic pre-treatments: (cleaning, selecting, grading, field heat removal), Pre-cooling: (forced draught, hydrocooling, vacuum cooling, ice-bank cooling) and Special treatments: (curing, ripening, fungicide application).

Introduction of the cold chain concept, where the produce is housed under controlled temperature and humidity conditions from harvest and treated to the point on sale. Maintaining a cold chain is essential to minimise the postharvest losses, attract quality conscious buyers and showcasing premium exotic products. The essential link feature in a cold chain are pre-cooling, cold storage before transported to market, cold room or cold storage at market place and refrigerated display. There seems to be a considerable percentage of waste associated with whole sale and retail trade and the wastage percentage is commodity specific[1]. Therefore it is suggested that introduction of cold storage facilities with pre-cooling facilities at the wholesale markets be popularised as an initial step to bring down the percentage of losses.

Organic farming is considered to be very healthy and commands a high premium in the international market. Horticultural crops grown in Arunachal Pradesh are mostly inorganic free and have an edge and can survive the difference of price margins from contending areas of the country. But management practises under international approved regulations are to be adhered. Crops are to be certified by an Inspection and Certification Agency duly accredited by one of the Accreditation Agencies designated by the Govt of India. International Federation for Organic Agricultural Movement (IFOAM), European Union (EU) Regulations and Codex standards are available for sale with the Accreditation Agencies.

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[1] Pre-investment study on development of cold storage Industries in North Eastern region. State Report Arunachal Pradesh

Electronic communication with the various buyers & sellers zone in India and abroad is essential to keep update of the national and international demands and trends. This can be done by individual growers and co-operative societies associated with agribusiness in the state. The concept of Agri Export Zone developed by APEDA is a valid strategic approach for market development both nationally and internationally. The Agri export zone attempts to take a comprehensive look at a particular produce/product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing/packaging, leading to final exports. Thus, the entire effort is centred on a clustered approach of identifying the potential products, the geographical region in which these products are grown and adopting an end-to-end approach of integrating the entire process right from the stage of production till it reaches the market. To make the projects viable, it is necessary that the Central and State Governments work closely with each other and would imply certain pro-active steps to be taken by the States with regard to, i) Identification of a State Government institutions/agency which will be responsible for co-ordination the activity. ii) Linkage of wholesale and retail markets to the AEZ co-ordinator in the state on a regular basis. iii) Officers in the State Agri Export Zones to interact regularly with APEDA and organise training/activity on a regular basis with a definite action programme. iv) Interaction between the state co-ordinating Agri Export Zone, APEDA, whole sale and retail market & entrepreneurs to be carried out through e-mail and Internet services (electronic). It is expected that the electronic connectivity would be achieved in a phase manner which would help access information and exchanges from other relevant export zones in the country and abroad.

Identify the product specific Agri export zones for end-to-end development for export from a geographically contagious area. Present in a chart format product & geographical area specific.

When produce are harvested and transported from the field to the storage facility or to various markets, a great deal of damage occurs. Therefore transportation at night or early morning is recommended as it can reduce the heat load. During transportation, produce should be clamped and secured in position to avoid damage. If an open-air vehicle is used, it should be loaded in a way to permit ventilation and cooling of produce. For transporting the produce over long road distances, management of temperature is critical. Proper air flow is the most important factor in keeping the produce cool. The loads should be stacked in a way that air circulation carries away heat from the produce and diffuses the incoming atmosperic heat. In case of transporting produce in closed containers, care should be taken that the container is well insulated to maintain cool environments for pre-cooled commodities. Loads should be fastened away from side walls and door. Farmers and traders should avoid transporting mixed loads of fresh perishable commodities in order to save cost which otherwise would result in loss of produce under uncompatible temperature. Besides grower s and traders should avoid mixing of ethylene producing commodities and ethylene sensitive commodities during transport as it can lead to physiological disorder or change in colour, flavour and texture in ethylene sensitive produce.

Agricultural Co-operative societies, farmers group and individual can undertake the role of a service provider for pre & post harvest management operations, polishing, packaging, cold storage, transport equipment, refrigerated vans, vapour heat treatment plant (VHT), x-ray screening facilities and emerge as Agri exporters. Since the state of Arunachal Pradesh is widespread, therefore installing and operating a VHT systems on a commercial basis would not be a viable venture. Hence a commercially viable area which should not be far from reach and economical and catering to a wider geographical coverage and having direct national international connectivity would be appropriate. Guwahati would be an appropriate location for facilitating the VHT technology through an entrepreneur.

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Electronic commerce for better trade opportunities

The common different mediums of electronic commerce (e-commerce) in the present age is telephone, fax, television, electronic payment and money transfer systems, Electronic Data Interchange (EDI) and Internet. Even though phone, fax and television remain the most widely used electronic mediums for commerce, a great amount of pace and excitement has been generated by the rapid dominance of Internet. Internet has made possible international transmission of services (electronic publishing, website design and management, customer call centers, etc.) possible to an extent, which cannot be facilitated via traditional modes such as fax, phone and television. Internet has also become a medium for electronic transmission of many products, traditionally traded in the form of goods.

Benefits

Consumers' benefit from electronic commerce by having a broader choice in the desired products globally available. Consumers' connecting to the Internet has access to every company engaging in electronic commerce, and hence the choice expands every time a new retailer goes online - provided regulatory or other barriers do not inhibit trade. The extraordinary expansion of goods and services available over the Internet has produced a number of additional benefits for consumers. One benefit is the opportunity to purchase or sell products and services at the lowest possible price. Search engines (yahoo, google, etc.) can enable a consumer to search a desired product among online sellers, compare prices for the product and select the seller with the lowest price without a compromise in the quality. The greatest benefit that e-commerce can provide is customized service that reflect the consumer's preferences, based on information about the consumer's. In addition to reflecting personal preferences, website customization can ensure that a consumer receives information only in his or her own language.

Electronic commerce can be a valuable marketing opportunity for local traders in a state like Arunachal Pradesh with smaller markets, and would be a gateway to larger markets worldwide. Ideally a traditional retailer has access only to the market where his business is physically located. Even a retail chain can sell only to people living in locations where the retailer has outlets. Electronic commerce can alter the size of a company's market, potentially expanding it to include every person with Internet access. Small and medium-sized enterprises (SMEs) are especially likely to benefit from competing in the electronic marketplace using tools as basic as a Windows PC, and connect easily to a large retailer's supply chain. Hence no longer does the size or location of a business determine the size of its potential market.

Electronic commerce can contribute solutions to a number of problems that governments and policymakers currently confront. An example is jobs creation in the IT sector. Governments can benefit from electronic commerce by reducing the cost of services providing to the public. Besides Government departments, which are major consumers of goods and services, will save money by communicating with vendors electronically and increasing competition for government contracts and open up markets for SMEs.

E-commerce policy

The explosive growth of electronic commerce conducted via the Internet is leading to a change in the ways of lives and provoke interest in businesses and governments alike. The key factor for its growth has been the relative lack of regulatory barriers, and entrepreneurs are free to create innovative products and services that respond to the opportunities and demands of the new electronic marketplace. The sheer magnitude of trade via internet has begun to attract the attention of policymakers who have raised concerns about the implications of an unregulated marketplace, and have also suggested new legislation. Therefore to coordinate this nascent legislative activity and ensure that trade barriers are not erected. It is proposed that WTO play an important role in this effort. But WTO Members have to reflect on the wide range of benefits that electronic commerce generates for consumers, companies, and governments, and recognize the need for a "light handed" and internationally consistent regulatory approach.

The WTO has recognized the burdensome customs procedures, inadequate customs resources, corruption, and excessive costs of administration impede trade and investment in all areas. The experience of Microsoft and other software companies confirms that these non-tariff barriers hinder trade in the technology sector[1]. It is believed that WTO would work toward a framework agreement covering, among other matters, greater cooperation between customs authorities, improved control of customs fraud, and strengthened measures to restrict trade in products violating intellectual property rights. From the viewpoint of multilateral rules of international trade as well as national economic policy, this medium gives rise to issues somewhat different from those faced with respect to other mediums. Therefore the WTO members must decide whether the GATT or GATS discipline should be applied to international trade.

Access to E-Commerce

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[1] WTO & Electronic Commerce Issues for world trade. A Microsoft white paper.

Access to e-commerce, can lead to access to e-exports, and the services can be distinguished under two separate components: (i) access to Internet services (infrastructure) and (ii) access to services that can be traded (commitments) electronically.

Access to Internet Services

The access to Internet infrastructure depends on two factors: (i) availability of communications networks, hardware and software and (ii) access to the existing communications networks.

(i) Availability of Infrastructure, Hardware and Software

At the basic level, access to Internet depends on the level of development of the telecommunications sector and the availability of hardware and software. In the remote villages of developing countries like India, even the basic telecommunications service may not exist. To bring Internet and e-commerce into these villages one will have to develop the existing telecommunication services along with the hardware that links up the individual users, followed by computers, software and modem[2]. However an alternate option can be through establishment of a VSAT (Very Small Aperture Terminal) linkup.

(ii) Access to the existing communications networks.

There are three principal WTO provisions that govern access to communications network: GATS Article VIII on monopolies and exclusive service suppliers, GATS Annex on Telecommunications, and the Reference Paper on regulatory principles in the Agreement on Basic Telecommunications. In addition, specific commitments on national treatment and market access made by countries in basic telecommunications sector have implications for access to Internet. Internet access also depends on the degree of liberalization undertaken by Members in basic telecommunications. A key area of liberalization from the viewpoint of Internet access is that of Internet Service Providers (ISP). In countries like India, telecommunications services are supplied by a public monopoly, which often also becomes the monopoly provider of internet access.

Access to Electronically Traded Services

Internet offers the opportunity for trade in areas like services outside of telecommunications sector such as those in banking, insurance and computer programme which can be delivered electronically. Besides, Internet can also become a vehicle for the provision of distribution services with goods and services purchased through Internet but delivered by other means. For transactions in the first category, GATS discipline applies fully. While, transactions made in the second category are similar to those by telephone or mail order. Deliveries made physically on, goods are subject to the usual GATT discipline including customs duties.

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[2] E-commerce, WTO and Developing Countries. A Panaganya

Info-communication Infrastructure in India[3]

Info-communication infrastructure in India with less than 1.3 telephone connections per hundred persons and less than 1 computer and Internet connection per hundred persons is a major obstacle. Necessary hardware and software elements must be in place to allow digitised data to flow. Besides, telecom networks must provide access to connect and operate for information exchange. Indubitably, physical infrastructure is a deciding factor for Internet connectivity. But e-commerce requires other operational hardware and software, such as safe and secure encryption system for deciphering a commercial transaction, along with standard physical infrastructure as Electronic transaction takes place through multiple platforms and stages, besides multiple players. Each stage and platform is critical to e-commerce and any missing link in the overall chain will stop the electronic transaction. Besides, each player has a dominant role to play in the linkage.

Major Players of Electronic Commerce	
Physical Infrastructure Owners	VSNL, MTNL, DOT, ERICSSON, AT & T, etc
System Operators & Service Providers	VSNL, MTNL, SATYAM, ROLTA, etc
Hardware & Software Providers	INTEL, COMPAQ, WIPRO, MICROSOFT, etc.
Content Providers	IBM, TATA CONSULTANCY SERVICES, CISCO, CMC, HCL, etc
Entrepreneurs	RE-DIFFUSION, MICROSOFT, MARUTI, TELCO, BAJAJ, etc
Consumers	Consumers

Note: Listed companies are doing business in India via Internet, Intranet, EDI, etc

The monopoly of state owned enterprises, like Videsh Sanchar Nigam Limited (VSNL), Department of Telecommunications (DOT) and Mahanagar Telephones Nigam Limited (MTNL), had resulted in restricted market access for private participation in infrastructure services. Thus, the penetration ratio of physical infrastructure is low. Recent changes in telecom policy, focussing on private investment in physical infrastructure facilities, have facilitated the growth of Internet connections in India. Technologically, India is almost at par with the leaders in info-communications systems. The technoware content is based on latest hardware platforms, including IBM mainframe, AS/400, HP, Unisys, UNIX boxes, MAC, PS/2, Novell LAN, SUN and others. The greatest strength lies in human

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Info-communication infrastructure in India. Prof B Debroy & Dr P D Kaushik resource capabilities. India ranks just behind the US in terms of English speaking scientific professionals

Absence of nation-wide connectivity and inter-connectivity between multiple Internet Service Providers (ISP) is major constraint for info-communication operating system. The new policy dispensation provides state-wide access under the dialing scheme of "17222" access, which connects a subscriber to the nearest ISP node. With more than 800 cities being available on STD/ISD link, the "17222" access is likely to overload the Indian trunk network designed for "high tariff, low loading time traffic". Connectivity via such networks is difficult with high waiting time and expensive usage.

The bandwidth provided by VSNL is different for different platforms. Each node is connected to a primary 512 Kbps circuit to national trunk network, and back. The international bandwidth at each of the six gateways is around 2 Mbps with the use of optical fibre submarine cables. India at few places is connected with FLAG (5 Gbps per fibre speed) and SEA-ME-WE-3 (10Gbps per fibre). However, local bandwidth (telephone cables) of 56 Kbps is not adequate for meeting India's requirements with the current level of subscribers and expanding business opportunities on the global network. Lower bandwidth increases downloading time and result in more trunk line usage hours. With new opportunities opening in e-commerce via multi-media content and audio-visual entertainment products, the low bandwidth will be a major impediment in terms of time and cost.

VSAT solution

Comsat Max's VSAT[4]

VSAT is a secure and reliable medium to connect geographically dispersed locations where electronic connectivity does not exist or are very poor. A VSAT is a small fixed earth station that provides a communication link required to setup a satellite-based communication network. In India Comsat Max's VSAT (Very Small Aperture Terminal) network provides nationwide data and voice connectivity to enterprises. Support for the VSATs is provided from 50 locations spread across the country. It has an extended C-Band hub in Turbhe (New Mumbai), and has built another hub which runs on the Ku-Band, very recently in New Delhi. VSAT networks offer value-added satellite-based services that is capable of supporting the Internet, data, LAN, voice/fax communications, and can provide dependable, private and public network communications solutions.

Comsat Max uses SkyBlaster 360E (a Ku-Band VSAT) uses a DVB (Digital Video Broadcast) standard to offer broadband Internet access to its customers. The product is a two-way satellite-based solution to enable interactive Broadband IP and

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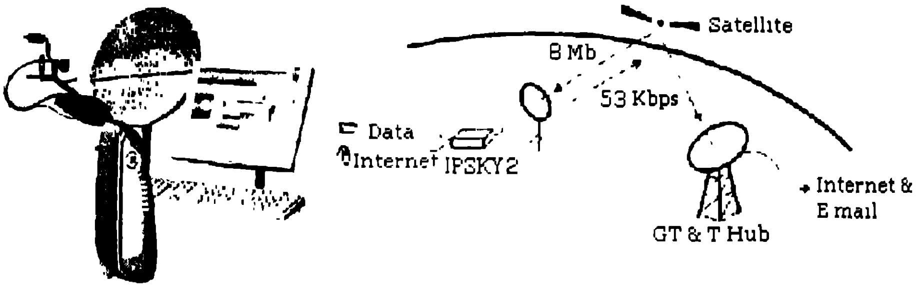
[4] Connectivity The VSAT Way. Network Magazine India

multicasting applications. Incorporating the DVB standard and IP capabilities, the SkyBlaster 360E supports most data and IP multicast applications.
The platform is able to network with the central hub through multiple locations spread across a wide geographical areas. "The SkyBlaster allows us to provide HTTP traffic acceleration and optimization, caching capabilities, QoS (Quality of Service), multimedia streaming applications like voice and video, and IP multicast applications."

IPsky2e - Fast Internet via satellite[5]

The V-Sat IPsky2e is a compact and low-cost satellite solution for the Internet. It consists of a small V-Sat satellite dish (0.8m, 1.2m or 1.8m) which can transmits and receives data to and from a satellite link to the Internet via the GT&T hub. The dish is mounted on a platform with a clear and unobstructed view of the sky to the south-east or full east. The antenna both sends requests to the Internet and receives Internet content via the satellite, which is in orbit approximately 36000 km above the equator. The satellite communicates with the GT&T hub, which has a direct connection to the Internet backbone.



The system is known as 'two way' as the service enables customers to receive and transmit together at high speed. Inside the workstation, the dish is connected by two standard coaxial cables to the V-Sat system modem. A personal computer (PC) is connected to the service via the satellite modem through a USB or an Ethernet port. The number of PCs connection can be increased by connecting the PCs into a Local Area Network (LAN) through the Ethernet port that can connect into the satellite mode.
The solutions provided by a IPsky2e: is high-speed Internet access, up to 52MB D.V.B. for downloading and 153.6 Kbps for uploading (307.2 Kbps option).
Extremely fast Internet access. Each unit supports an Ethernet and a USB port for the connection to a PC or to a network, remote control and monitoring, ultra-low power consumption (25W). The modem weighs 3.9 kg and is very small (height: 6

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[5] Global Telephone & Telecommunication

cm, width: 40 cm and depth: 34 cm). For this solution, an antenna between 98 cm, 1.2 m and 1.8 m is sufficient.

Project profiles

A sample project for establishing one hectare Orange orchards

INTRODUCTION

Citrus fruits have a prominent place among popular and extensively grown tropical and sub-tropical fruits. They posses greater adaptability to different climatic conditions, so are grown with equal success in tropical, sub-tropical and even in some favorable parts of the temperate regions of the world. They are not only delicious and refreshing to eat, but also provide vitamins, minerals and many other essential substances, which are required for human health. They are especially important for growing children and are an important source of vitamin c.

FRUIT CHARACTERISTICS

The size of fruit is medium to large, flattened or depressed globose. The colour of mature fruit is yellow, reddish orange. The rind is thin, rind and segments are easily separated. The number of segment is 10-14. The pulp quality is exceptionally fine

VARIETIES

Nagpur Santra, Khasi mandarin, Desi Mandarin, Coorg orange

AGRO-CLIMATE

Climate

Mandarin require subtropical and tropical climate. They grow well in submountane tracts with elevation from 600-1100 m, and rainfall ranging from 75-250 cm

Soil

Medium to light loam, deep, well drained soil having adequate amount of organic matter are suitable for mandarin. The effective soil pH ranges from 5.5 to 8.0

PROPAGATION

The mandarins are largely propagated by seed. Plants can be propagated by budding also. Budded plants bear fruit early, which will be of great economic value over the seedling trees.

SPACING

5.0 m x 5.0 m

PLANTING

Before monsoon, pits of size 0.75 m x 0.75 m with a spacing of 5.0 m x 5.0 m are prepared and then refilled with soil and manure mixture (1:1) and then allowed to settle. The plants are set at the center of the pits and the soil around is compacted. Mulching with dry leaves should be done

PLANTING TIME

May to August

INTERCROPPING

In young non-bearing orange orchards green gram and pineapple can be grown successfully a intercrop.

INTER CULTURE

Regular weeding, and replacement of old and diseased plant should be done.

PRUNING AND TRAINING

In the nursery stage pruning and training should be done soon after the seedling starts sprouti from the seed or scion buds have started growing. After planting at the main field, all side branches should be removed up to 50-60 cm from the ground level keeping only single main t trunk. Above 50-60 cm height, pruning is confined to the training to develop mechanically stro trees. The side branches at the main trunk should be allowed to grow in a spiral manner from base of the plant top. All diseased, injured, cris-cross branches and water sprouts should be removed.

IRRIGATION

Plants should be irrigated regularly at fortnightly interval during dry period.

MANURES AND FERTILIZERS

In the first year of planting no fertilizer if applied to the plants. Manure and fertilizers should be applied in two split doses, i.e., February/March and September/October. Fertilizers should be applied leaving about 15-45 cm space around the tree trunk and well beyond the canopy spread. Immediately after application of fertilizers, it should be incorporated into the soil by light or shallow hoeing. However, for organic fruit production it is important to apply organic based fertilizer and manure.

PLANT PROTECTION

To control trunk borer prophylactic smearing of BHC dust with lime and water should be applied up to 1 m from the base of the tree during March/April, which prevent the adult from laying eggs To control shoot borer, bark eating caterpillar and leaf miner spraying with monocrotophos (0.04%) starting from March to October at an interval of 20 days. For diseases like Phytophthor disease, scab phytosanitary measures should be taken and Bordeaux mixture should be applied a regular interval. Similarly, organic pesticides need to be tested for pest and disease control.

HARVESTING / YIELD POTENTIAL

After 7-10 years, the seedling starts bearing. Fruits should be harvested at proper maturity stages and harvested with care. After harvesting fruits should be collected in a bag and gently placed on a gunny carpet. Subsequently, they should be packed in bamboo basket or cartoons for transportation to the market. About 800-2000 fruits per plant per year can be obtained from a 30-40 years old orchard.

PACKING

Fruits are packed in bamboo baskets or wooden crates. The fruits are wrapped with paper individually before arranging in containers.

POST HARVEST HANDLING AND STORAGE

After harvesting, unwanted fruits are sorted out. Fruits are packed in bamboo basket and wooded boxes. The fruits are wrapped with paper individually before arranging in containers. The storage life can be prolonged under cold storage at 2-4° C, with 80-95 per cent relative humidity.

USES

The fruits are used as table purposes. In addition to consumption as fresh fruits, fruits can also be used for making juice, which is excellent for drinking purpose.

Establishment cost and return of one hectare orange orchards

Establishing an orange orchard require investment in different activities right from land development to harvesting of fruit. To promote the development of this fruit crop some basic requirements such as quality planting material, pre and post harvest management practices, fruit processing unit to fetch higher prices, credit support from financial institutions is necessary. In terms of economic returns, the activity would be technically feasible and economically viable because of productivity levels per unit areas of land, organic nature of fruit production and higher demand of organic fruit from other countries.

Since, the development of this crop is at its initial stage and large size orchard of orange fruit are yet to take place, a tentative cost benefit analysis has been worked out for 1 Ha (one hectare) orange orchard considering recommended package and practices and information given by private growers. For the present model an average yield at the stabilization stage (after 7-10 years) has been assumed at 1000 fruit/ plant. Similarly, there is lot of variation in market prices, but an average price of Rs 1.50/- per fruit has been considered to work out returns.

Table.1 Cost of development of one hectare orange orchard (Rupees)

Sl.No.	Cost	Year							
		1	2	3	4	5	6	7	Total
1	Land Preparation	5 000	-	-	-	-	-		5 000
2	Layout (Marking, pegging, layout etc.) 10 man days @ Rs 50/manday	500	-	-	-	-	-	-	500
3	Digging of 400 pits of 0.75 m x 0.75 (Rs 1/- per pit	400	-	-	-	-	-	-	400
	Cost of farm yard manure 25 t FYM (about 3 truck load) @ Rs 1200/truck load	3 600	-	-	-	-	-	-	3 6C

4	Filling of pits with soil, manure, etc. (Rs.3/- per pit)	1 200	-	-	-	-	-	-	
5	Cost of plants @ Rs.10 per plant (including 10% extra for gap filling)	4 400	-	-	-	-	-	-	4
6	Planting 50 mandays @ Rs.50/manday.	2 500	-	-	-	-	-	-	2
7	Watering	1 000	1 000	500	500	500	500	500	4
8	Plant protection operations including equipments	3 000	500	500	500	500	500	500	6
9	Training & pruning	500	500	800	800	800	800	800	5
10	Weeding and other intercultural operation: 40 mandays @ 50/mandays	2 000	2 000	2 000	2 000	2 000	2 000	2 000	14
11	Workable fence with annual maintenance	5 000	500	500	500	500	500	500	8
12	Harvesting cost (including handling, cleaning, washing, packing) 50 mandays	-	-					2 500	2
13	Tools (Secateurs, Knife etc.)	2 000	-	-	-	-	-	-	2
14	Watch man (1 NO) @ 1500/month	18 000	18 000	18 000	18 000	18 000	18 000	18 000	1 26
15	Miscellaneous	5 000	-	-	-	-	-	-	5
	Total	54 100	22 500	22 300	22 300	22 300	22 300	24 800	1 90

Table 2. Yield & Income from one hectare orange orchard: (Rupees)

Sl No.	Year	1	2	3	4	5	6	7 and onwards
1	Yield (No of fruit/plant)	-	-	-	-	-	-	1000
2	Production (No/ha)	-	-	-	-	-	-	400000
3	Income/ha @ Rs. 1.50/fruit							600000

Table 3. Cash flow statement (Rupees)

Sl. No	Year	1	2	3	4	5	6	7 & Onwards	To
1	Outflow cost	54 100	22 500	22 300	22 300	22 300	22 300	24 800	1 90
2	Inflow income	-	-	-	-	-	-	6 00 000	6 00
3	Net income	-	-	-	-	-	-		4 09

Project profile for floriculture unit

Cymbidium cultivation for cutflower in Arunachal Pradesh

Arunachal Pradesh has more than 600 species of orchids occurring in various forest types some of them are rare and endemic to the region. Orchids are known for aesthetic values due to diverse color, size, shape, ornamentation and longer vase life. Ornamental orchids especially Cymbidium grows in subtropical region (500-1800 m msl) in well drained loamy soil with 8-24°C temperature and 60-70% natural shade.

Cymbidium could be cultivated under artificial Agroshade house commercially in a sustainable way. In general gestation period for first harvest as cutflower is in the 4th year. Thereafter annual harvesting of cutflower continues along with back bulbs. Commercial cultivation of Cymbidium in a sustainable way is calculated in the following tables.

Unit Cost Development of Cymbidium orchids in Nursery beds in Arunachal Pradesh

Unit size – 500 m^2 ; Number of seedling = 2500
Planting Materials = 1 year old seedlings.

A. Cost of Development.

Sl.No.	Particulars	Cost			
		1st year	2nd Year	3rd Year	Total Cost
1	Shed (20 X 25m)				
	a. Bamboos, 2000 nos @ Rs. 15 each	30000			30000
	b. G.I wire, 150 kg @ 40 kg	6000			6000
	c. Netlon shade, 500 sq.m. @ Rs.40	20000			20000
	d. Wooden post, 50 nos @ Rs40 each	2000			2000
	e. Boulders stones and pebbles 5 trucks @Rs 1200 per truck	6000			6000
2	Compost mixture				
	a. Top soil, 4 trucks @ Rs 1000 per truck	4000			4000
	b. River Sand, 2 trucks @ Rs. 1200 per truck	2400			2400
	c. Cow Dung, 2 trucks @ Rs.1200 pr truck	2400			2400
	d. charcoal, 1000kg. @ 5.00per kg.	5000			5000
3	Labour for Construction				
	a. Labour for construction, mandays230, @ Rs 70 m d.	16100			16100
	b. Site development including trenching, terracing and fencing, water facility	10,000			10,000
4	Fertilizers and flower boosters	1,000			1,000
5	Chemicals, fungicide pesticide etc. and equipment like sprayer	4,000	2,400	2,400	8,800
6	Cost of planting materials @Rs 11 each (for local farmers only)	27,500			27,500
7	Maintenance With one D/L and other inputs		18,000	18,000	36,000
8	Miscellaneous	2,000			2,000
	Total	138400	20,200	20,200	179200

B. Yield and Profit

10	Yield							
	a. Year	1	2	3	4	5	6	7
	b. No of Spikes	-	-	-	2,500	5,000	7,500	10,000
	c. back bulbs	-	-	-	2500	-	2500	2500
	d. Farm gate price @ RS. 25 per spike	-	-	-	62500	125000	187500	250000
	e. back bulb @ Rs. 30 /- per bulb	-	-	-	75000	-	75000	75000
11	Total earning	-	-	-	137500	125000	262500	325000

Table no. **Cost Benefit Analysis**

Sl No.	**Particulars**	**Year wise in Rs.**							**Total (Rs)**
		1st	2nd	3rd	4th	5th	6th	7th	
1	Input	138400	20,200	20,200	20,200	20,200	20200	20200	259600
2	Output								
	Spikes				62500	125000	187500	250000	625000
	Bulbs				75000	-	75000	75000	225000
3	Net Profit (2-1)	-	-	-	117300	104800	242300	304800	590400

Thus with efficient farming management practice one can earn to the tune of Rs.590400.00 after initial investment of Rs. 259600.00 over a periods of seven years.

Project profile for medicinal plants

Cultivation of Ginseng (Panax ginseng)

Ginseng is a perennial herb used for centuries in Asia for medicinal purposes. Ginseng is also reported from Temperate areas (Bomdila, Tawang area) of Arunachal Pradesh. Ginseng prefers well drained deep loamy humus soil with pH ranges from 5.5-6.0, 70-90% natural or artificial shade, annual average tenperature10°C and annual rainfall 92-110 cm.

Ginseng could be grown commercially either under closed Agroshade house condition or under natural tree shades where microclimate requirements are fulfilled. Ginseng is grown either by sowing seeds or planting roots or seedlings with a spacing of 20 x20 cm apart. Most ginseng crops are started from seeds rather than roots or seedlings. This is the least expensive way to start a plantation. Ginseng requires 3 to 5 years to produce a marketable crop from seed. In general ginseng plants bear fruit after 3rd or 4th years of age. Thus a farmer may opt for harvesting roots after 4th or 5th year or may wait till 12 years with annual seed collection. Harvested roots are air dried for marketing. In the following tables cultivation of ginseng and its economic is presented for commercial farms to begin.

Package for [illegible] shades.
Area 8m X [illegible]
Planting mat[illegible] [illegible] cm.

Sl No.	Particulars	Cost Year wise in Rs. 1	2	3	4	Total
[illegible]	Shade [illegible]					
	a. Bamboo [illegible]	[illegible]				12,000
	nos. [illegible]					
	each	[illegible]				4,000
	b. GI wire [illegible] Kg					
	340 Kg	[illegible]				8,000
	c. Agroshade [illegible]					
	@Rs [illegible]	[illegible]				1,400
	d. Wooden [illegible]					
	[illegible]	[illegible]				3,600
	each					
	[illegible]					
[illegible]	Compost [illegible]					
	a. Top [illegible]					2,000
	trucks [illegible]					
	1000 [illegible]	[illegible]				1,200
	b. River sand [illegible]					
	truck [illegible]	[illegible]				1,200
	c. Cow dung [illegible]					
	truck [illegible]					

3	Labour for construction a. Mandays 30, @ 70 b. Site development including trenching, fencing, irrigation etc.	2100 10,000				2,100 10,000
4	Fertilizer	1,000				1,000
5	Chemicals, pesticides, fungicides and small equipment	4,000	2000	2000	2000	10000
6	Cost of planting materials ½ Kg @ 10000 per Kg	5,000				5000
7	Maintenance 1 D/L and other inputs		30,000	30,000	30,000	90,000
8	Miscellaneous	5,000				5000
	Total	60,500	32,000	32,000	32,000	1,56,500

Table analysis of yield

Sl No.	Yield	Return in Rs.				
		4	5	6	7	Total
1	Seeds production 11 Kg (444 plants bear 1 Kg seed approx.)	11	11	11	11	**44Kg**
2	Cost of seeds @ 10000 per kg	1,10,000	1,10,000	1,10,000	1,10,000	**Rs. 4,40,000**
3	Roots 150 Kg fresh weight (every root become 15 gram approx. Or 50 Kg dried weight (after drying 1/3 of the fresh weight is retained)	50 (after 7th year roots could be harvested)				**50 Kg**
	Cost of dried roots @ Rs.17,000 per Kg	8,50,000				**Rs. 8,50,000**
	Total					12,90,000

*Cost of ginseng either root or seeds are calculated on the basis of International market price

Table no. **Cost Benefit Analysis**

Sl No.	**Particulars**	**Year wise in Rs.**							**Total**
		1st	2nd	3rd	4th	5th	6th	7th	
1	Input	[illegible]	[illegible]			[illegible]	32000	32000	252500
2	Output								
	Seed				-	[illegible]	[illegible]	110000	440000
	Root							850000	850000
3	Net Profit (2-1)				-	[illegible]	[illegible]	928000	1162000

Therefore [illegible] management practices a farmer can earn to the [illegible] the end of 7th year with an investment of Rs. [illegible]

Administrative set-up showing districts. subdivisions. blocks and circles in Arunachal Pradesh

Name of the Dist.	Sub-Divisions	Name of the Blocks	Name of the Circles
Tawang	1 Tawang	1 Tawang	1.Tawang 2.Dudunghar
		2 Mukta	1.Thingbu 2. Mukto
	2 Lumla	3 Lumla	1.Lumla 2.Zemithang
West Kameng	1 Bomdila	1 Dirang	1.Dirang
	2 Thrizino	2 Nafra Buragaon	1.Trizino 2. Nafra 3.Jameri 4.Bhalukpong 5.Bomdila
	3.Rupa	Klaktang	1.Kalaktang 2.Rupa 3.Balemu
East Kameng	1 Seppa	1 Seppa	1.Seppa 2. Pipu Dipu 3.Richukrong 4.Veo
		2 Pake-Kesang	1.Seijosa 2.Pakekesang 3. Lada
	2 Chayangtajo	3 Chayangtajo	1.Chayangtajo 2.Sewa
		4 Bameng	1.Khenowa 2.Bameng
Papumpare	1 Itanagar	1 Doimukh-kimin	1.Kimin 2.Doimukh 3.Balijan 4.Naharlagun 5.Itanagar 6.Mengio
	2 Sagalee	2 Sagalee	1.Sagalee 2.Mengio
			3.Laponang 4.Toru
Lower Subansiri	1 Ziro I	1 Ziro	1.Ziro
		2 Yachuli	1.Yachuli 2.Pistana
		3 Palin	1.Palin 2.yangte
		4 Chambang	1.Chambang
		5 Tali	1.Tali 2.Lengdingkoling
		6 Raga	1.Raga 2.Dolhumukh
	2 Kolonang	7 Kolonang	1.Kolonang 2.Sarli
		8 Damin	1.damin 2.Parsiparlo
		9 Nyapin	1.Nyapin 2.Sangram
Upper Subansiri	1 Daponjo	1 Daponjo	1.Daponjo 2.Puchigeko
		2 Giba	1.Giba
		3 Dumponjo	1.Dumponjo 2.Banrijo
		3 Taliha	1.Taliha 2.Payeng
	2 Nacho	4 Nacho Siyum	1.Taksing 2.Limeking 3.Siyum 4. Nacho
West Siang	1 Along	1 Along	1.Along 2.Bagra
	2 Rumgong	2 Rumgong	1.Rumgong 2.Jamlomobu
		3 Kaying-Payum	1.Kaying 2.payum
	3 Basar	4 Basar	1.Basar 2.Tirbin 3.New Daring
	4 Likabali	5 Gensi	1.Gensi 2.Likabali 3.Kangku
	5 Yomcha	6.Liromoba	1.Liromoba 2.Yomcha 3.Darak
	6 Mechula	7 Mechuka	1.Mechuka 2.Monigong 3.Tato 4.Pidi

Name of the Dist.	Sub-Divisions	Name of the Blocks	Name of the Circles
East Siang	1.Pasighat	1.Pasighat	1 Pasighat 2.Bilat
	2.Ruskin		3.Ruksin 4.Oyan
		2. Mebo	1.Mebo
	3.Nari	3.Ramle Banggo	1.Nari 2.Koyu 3 New Seren
	4 Boleng	4.Pangin-Boleng	1 Pangin 2.Boleng 3.Riga 4.Rebo Perging
Upper Siang	1.Mariyang	1.Mariyang	1.Mariyang 2 Geku 3 Katan
	2.Yingkiong	2.Yingkiong	1.Yingkiong
		3.Jengging	1.Jengging
	3 Tuting	4.Tuting	1 Tuting 2 Singa 3 Gelling 4 Palling 5.Migging
Dibang Valley	1.Anini	1.Anini-Etalin	1.Anini 2.Etalin 3.Mipi
	2.Hunli	2.Hunli-Kronli	1.Hunli 2.Kronli 3 Desali 4 Anelih
	3.Roing	3 Roing-Dambuk	1 Roing 2 Dambuk 3 Koronu
Lohit	1.Tezu	1 Tezu	1 Tezu 2 Sunpura
	2.Namsai	2.Namsai	1 Namsai 2 Lekang 3 Chowkham 4 Piyong
		3 Wakro	1 Wakro
	3.Hayuliang	4.Hayluliang	1 Hayuliang 2 Changlagam 3 Goiliang 4 Manchal
		5.Hawai	1.Walong 2 Hawai 3 Kibithoo.
Changlang	1 Cahnglang	1 Changlang	1 Cahnglang 2 Khimiyong 3 Namtok
		2 Nampong-Manmao	1.Jayrampur 2 Nampong 3.Manmao
	2.Miao	3 Khagam-Miao	1 Miao 2 Vijaynagar 3 Kharsang
		4.Bordumsa-Diyun	1 Bordumsa 2.Diyun
Tirap	1.Khonsa	1 Namsang	1 Khonsa 2 Lazu 3 Namsang
	2 Longding	2.Niausa	1 Longding 2 Pumao 3 Kanuban
		3 Pongchau-wakka	1 Pongchau 2 Wakka
Total 13	36	56	149

Source: *Statistical Abstract of Arunachal Pradesh*

Land use pattern in Arunachal Pradesh

	Dibang Valley	East Kameng	West Kameng	Lohit	Papumpare	Tawang	Tirap	Changlang	East Siang	West Siang	Uppar Siang	Lower Subansin	Upper Subansin	Total
Geog Area in Sq Kms	13029	4134	[illegible]	[illegible]	2875	2172	7024	This	[illegible]	7643	6188	10135	7032	83743 00
Gullied land								District						0 00
LandWith-out Scrub	120 33	190 62	770 72		108 38	530 32		is newly	160 61	813 66	280 76	394 64	46 74	3326 78
Waterlogged land	3		0 86	[illegible]		0 14	8 04	formed				0 83		41 47
Saline Land								out of						0 00
Jhum land	121 1	283 96	523 48	[illegible]	[illegible]	70 75	1100 56	Tirap	14 23	199 28	[illegible]	[illegible]	26 31	3055 05
forest waste Land	53 4	2 82	30 41	[illegible]	45 11	5 55	324 12	District	11 93	47 41	5 73	12 24	5 95	1416 67
Grazing Land	1074 65	0 3	5 01	654 35	19.51	1 98	24 95	and	71 65			0 59	282	2134 99
Plantation Crop land		0 04			6 03			the						6 07
Coastal/Sands	99 45	2.35	3 65	149.83		0.09	12 73	Statistics	41 33			-	-	309 43
Mining wasteland	-	-			-	0 3	-	included		-	-	-	-	0 30
Barren/rocky area	363 35	94.8	20.33	74.93	2 85	141 06	0.21	in the	4 17	137.97	94 45	206 21	122.03	1262 36
Steep sloping Area		-	0 43	-	-	0.28	7.22	combined	-	-	-	-	-	7 93
Snow area	1564.29	474.25	212 22	444.47	14.17	540.49	142.43	Tirap		836.4	581.15	914 22	1008.08	6732 17

source : 1: 50000 scale wasteland maps prepared from landsat Thematic Mappers /IRS/LISS II/III Data. Wasteland Atlas of India. 2000

Comprehensive productivity trend in Arunachal Pradesh, 1990-2000

Crop	90-91	92 93	92 93	94 95		95-96		96-97		97-98		98-99		99-00	
Apple	1.90	1.82	-4.00%	1.62	11.05%	2.18	34.32%	3.44	58.03%	2.39	-30.51%	2.47	3.49%	1.25	-49.37%
Plum		2.08		3.02	45.35%	2.40	20.36%	4.45	85.39%	3.11	30.21%	3.25	4.48%	3.44	6.03%
Walnut	0.11	0.30	185.43 %	0.40	32.70%	0.35	12.70%	1.00	187.57 %	0.46	53.88%	2.04	342.07%	0.02	98.88%
Citrus		1.65		1.50	9.17%	1.96	30.77%	2.73	39.33%	2.59	4.96%	2.41	6.82%	1.49	38.25%
Guava	2.06	1.68	-18.35%	2.35	39.94%	2.46	4.53%	2.71	10.19%	2.60	4.12%	2.59	0.47%	2.88	11.46%
Strawberry															
Pomegranate		0.93		1.43	53.89%	0.92	35.70%	1.43	54.95%	1.32	7.47%	1.38	4.66%	1.47	5.94%
Peach		2.23		3.09	38.53%	3.05	1.11%	4.42	44.66%	4.24	3.98%	4.45	4.83%	4.71	5.93%
Pear		2.72		3.04	11.76%	2.92	3.79%	5.58	91.02%	3.07	-44.89%	3.11	1.08%	3.34	7.39%
Grape				1.00		1.00	0.00%	1.00	0.00%	0.58	-41.67%	0.58	0.00%	0.64	9.09%
Pine apple	4.75	3.71	-21.77%	2.54	-31.70%	3.17	25.08%	3.92	23.55%	4.07	3.73%	4.15	2.06%	4.37	5.36%
Banana	5.52	4.56	-17.40%	3.92	-13.91%	2.51	-35.92%	3.57	42.03%	3.29	-7.81%	3.40	3.33%	3.48	2.24%
Papaya		1.67		3.40	103.48 %	3.40	0.01%	5.58	64.11%	4.30	-22.90%	4.50	4.69%	4.78	6.23%
Kiwi				1.36										0.04	
litchi		0.70		1.67	137.05 %	0.44	-73.66%	0.52	17.86%	0.43	-17.03%	0.37	-13.26%	0.33	-9.98%

Source: Statistical Abstract. Govt.of Arunachal Pradesh 1990-2000

nex.-III / III.2.

[illegible] ty of *West Siang* Dist 1992 2000

1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
[illegible]	Prodn	yield	Area	[illegible]	[illegible]	Area	[illegible]	[illegible]	[illegible]	[illegible]	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prod	yield
141	192	1 36										4			46	138	3 00	14		
32	95	2 97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2 89	46	131	2 85	4			46	146	3 17
32	70	2 19										1		0 00	3638	10803	2.97	8		0 00
1487	3634	2 45	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2 85	102	393	3 85	3722	5810	1 56
50	340	6 80	90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3 50	102	374	3 67				102	417	4.09
1485	3634	2 45																		
40	164	4 10																		
80	570	7 13	60	120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	61	117	1 92	61	123	2 02	61	130	2 13
1450	7368	5 08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4980	18604	3 74	4978	19089	3 83	4982	20234	4 06
110	400	3 64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	595	1074	1 81	646	1127	1 74	696	1195	1 72
121	219	1 81																		
												3			3			3		
39	95	2 44										12			19			24		

Source: Statistical Abstract of Arunachal Pradesh 199[illegible]

[illegible] production & Productivity of *Papumpare* Dist 1992 2000

1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
[illegible]	[illegible]	Pty	Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	pty
70	50	0 71	73	165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	180	[illegible] 47	73	180	2 47	73	189	2 59	73	200	2 74
107	112	1 05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	97	80	0 82	122	84	0 69	177	36	0 20
33	60	1 82	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	250	[illegible]	40	267	6 68	40	280	7 00	40	297	7 43
40	40	1 00	37	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	32	[illegible]	37	34	0 92	37	38	1 03	37	40	1 08
21	13	0 62	21	96	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	125	[illegible]	21	133	6 33	21	140	6 67	21	148	7 05
68	60	[illegible]	32	65	[illegible]	32	65	[illegible]	[illegible]	65	2 03	32	70	2 19	32	74	2 31	32	78	2 44
97	295	3 04	97	430	[illegible]	97	560		97	560	5 77	111	599	5 40	117	614	5 25	117	651	5 56
50	60	1 20	75	132	[illegible]	74	125	[illegible]	89	150	1 69	105	161	1 53	113	169	1 50	121	179	1 48
40	30	0 75	43	100	[illegible]	48	120	[illegible]	50	160	3 20	50	171	3 42	50	179	3 58	50	190	3 80
13	17	1 31	.	.								7			17	.		32		

Source: Statistical Abstract of Arunachal Pradesh in respective Years, Itanagar

Area, production & productivity of *Changlang* dist, 92-00

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	Pty *	Area	Prodn	Pty *	Area	Prodn	Pty *	Area	Prodn	Pty *	Area	Prod	Pty *	Area	Prodn	Pty *	Area	Prodn	Pty *
Apple	37	69	1 86	37	80	2 16	37	80	2 16	37	80	2 16	37	85	2 30	37	89	2 41	37	30	0 81
Plum	25	40	1 60	25	70	2 80	25	70	2 80	26	70	2 69	26	72	2 77	26	76	2 92	26	82	3 15
Walnut	20	3	0 15	27	7	0 26	27	7	0 26	27	7	0 26	27	8	0 30	27	8	0 30	27		0 00
Citrus	285	460	1 61	287	425	1 48	117	255	2 18	112	285	2 54	134	304	2 27	150	319	2 13	187	150	0 80
Guava	68	125	1 84	70	180	2 57	90	200	2 22	95	110	1 16	97	117	1 21	97	123	1 27	97	130	1 34
Strawberry	-	-																			
Pomegranate	25	9	0 36	26	30	1 15	26	26	1 00	26	35	1 35	26	37	1 42	26	39	1 50	26	41	1 58
Peach	43	52	1 21	50	155	3 10	50	155	3 10	50	203	4 06	50	217	4 34	50	228	4 56	50	242	4 84
Pear	40	105	2 63	43	164	3 81	43	164	3 81	43	114	2 65	47	122	2 60	50	128	2 56	54	136	2 52
Grape	-	-																			
Pine apple	235	380	1 62	115	1202	10 45	115	1252	10 89	115	1510	13 13	120	1615	13 46	123	1657	13 47	129	1756	13 61
Banana	240	900	3 75	310	1005	3 24	360	775	2 15	370	860	2 32	375	952	2 54	329	1000	3 04	343	1060	3 09
Papaya	51	77	1 51	55	159	2 89	65	170	2 62	65	220	3 38	65	235	3 62	65	246	3 78	65	260	4 00
Kiwi																					
litchi	43	30	0 70	45	32	0 71	15	10	0 67	29	20	0 69	39	22	0 56	50	21	0 42	60	22	0 37

Source Statistical Abstract of Arunachal Pradesh in respective years

Area, production & productivity of Dibang Valley Dist

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prodn	Yield
Apple	154	235	1 53	-	-		20	5	0 25	35	10	0 29	40	11	0 28	43	12	0 28	42	2	0 05
Plum	43	215	5 00	63	195	3 10	65	195	3 00	63	165	2 62	63	167	2 65	63	174	2 76	63	184	2 92
Walnut	3	1	0 33	3	1	0 33	3	1	0 33	3	1	0 33	5	2	0 40	7	2	0 29	7		0 00
Citrus	120	72	0 60	299	658	2 20	215	348	1 62	230	385	1 67	255	412	1 62	308	432	1 40	375	212	0 57
Guava	49	75	1 53	59	96	1 63	65	100	1 54	75	100	1 33	78	107	1 37	78	112	1 44	78	119	1 53
Strawberry	-	-														-	-		0		
Pomegranate	6	4	0 67	5	5	1 00	5	4	0 80	5	5	1 00	5	5	1 00	5	5	1 00	5	5	1 00
Peach	19	124	6 53	19	37	1 95	19	37	1 95	19	56	2 95	19	60	3 16	19	63	3 32	19	67	3 53
Pear	105	261	2 49	25	88	3 52	25	88	3 52	25	90	3 60	25	96	3 84	25	100	4 00	25	106	4 24
Grape	-	-		-	-																
Pine apple	92	275	2 99	40	395	9 88	40	380	9 50	40	380	9 50	43	407	9 47	43	417	9 70	51	442	8 67
Banana	125	500	4 00	374	1610	4 30	390	488	1 25	400	600	1 50	420	642	1 53	430	674	1 57	445	714	1 60
Papaya	29	57	1 97	40	360	9 00	40	370	9 25	40	391	9 78	40	418	10 45	40	440	11 00	40	466	11 65
Kiwi																					
litchi	16	19	1 19	19	25	1 32	13	13	1 00	20	20	1 00	27	22	0 81	34	24	0 71	43	25	0 58

Source Statistical Abstract in Arunachal Pradesh1992-2000

Area, production & productivity of *Lohit Dist* in respective years.

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prodn	yield
Apple	83	170	2 05	42	12	0 29	22	7	0 32	22	7	0 32	22	9	0 41	22	10	0 45	22	2	0 09
Plum	48	70	1 46	12	50	4 17	12	50	4 17	12	70	5 83	12	72	6 00	12	76	6 33	12	82	6 83
Walnut	22	8	0 36	12	-		12		0 00	12		0 00	12	2	0 17	12	2	0 17	12		0 00
Citrus	348	982	2 82	635	1093	1 72	100	373	3 73				171	406	2 37	199	426	2 14	246	240	0 98
Guava	152	40	0 26	50	111	2 22	65	150	2 31	90	230	2 56	92	246	2 67	92	258	2 80	92	273	2 97
Strawberry	-	-														-	-				
Pomegranate	5	8	1 60	20	1	0 05	2	1	0 50	2	5	2 50	2	5	2 50	2	5	2 50	2	5	2 50
Peach	47	70	1 49	12	24	2 00	12	24	2 00	12	35	2 92	12	37	3 08	12	38	3 17	12	40	3 33
Pear	50	153	3 06	30	35	1 17	30	35	1 17	30	45	1 50	30	48	1 60	30	50	1 67	30	53	1 77
Grape	-	-		-	-																
Pine apple	145	820	5 66	63	335	5 32	76	370	4 87	76	370	4 87	79	395	5 00	89	395	4 44	99	419	4 23
Banana	400	3800	9 50	150	1079	7 19	170	830	4 88	180	900	5 00	194	963	4 96	200	1011	5 06	210	1072	5 10
Papaya	35	42	1 20	40	102	2 55	50	112	2 24	52	152	2 92	52	162	3 12	52	170	3 27	52	180	3 46
Kiwi																					
Litchi	25	22	0 88	12	5	0 42	203	70	0 34	230	80	0 35	245	86	0 35	255	90	0 35	273	95	0 35

Source: Statistical Abstract of Arunachal Pradesh,1992-00

Area, production, productivity of *Tirap dist.*1992-00

	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prodn	yield
Apple	58	75	1 29	-	-											-	-				
Plum	25	18	0 72	43	145	3 37	43	145	3 37	45	190	4 22	45	175	3 89	45	184	4 09	45	195	4 33
Walnut				-	-											7	-		15		0.00
Citrus	212	682	3 22	246	705	2 87	135	205	1 52	139	212	1 53	172	226	1 31	203	237	1 17	297	130	0 44
Guava	62	45	0 73	85	180	2 12	115	215	1 87	120	297	2 48	122	317	2 60	122	333	2 73	122	353	2 89
Strawberry	-	-														-	-				
Pomegranate	17	10	0 59	17	24	1 41	17	17	1 00	17	30	1 76	17	32	1 88	17	34	2 00	17	36	2 12
Peach	45	75	1 67	45	70	1 56	45	70	1 56	45	92	2 04	45	98	2 18	45	102	2 27	45	108	2 40
Pear	58	80	1 38	58	90	1 55	58	70	1 21	58	70	1 21	58	74	1 28	58	78	1 34	58	83	1 43
Grape	-	-		6	6	1 00															
Pine apple	195	249	1 28	50	365	7 30	50	75	1 50	50	75	1 50	58	80	1 38	58	82	1 41	62	87	1 40
Banana	270	610	2 26	320	870	2 72	360	450	1 25	406	700	1 72	426	749	1 76	431	786	1 82	440	833	1 89
Papaya	70	37	0 53	75	235	3 13	85	250	2 94	27	280	10.37	87	300	3 45	87	315	3 62	87	334	3 84
Kiwi																					
Litchi	33	11	0 33	7	9	1 29	4	3	0 75	12	10	0 83	22	11	0 50	32	12	0 38	46	13	0 28

Source: Statistical Abstract of Arunachal Pradesh in respective years

Area, production & productivity of *Upper Siang* Dist1995-00

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prodn	yield
Apple																-	-				
Plum							55	140	2 55	55	150	2 73	55	152	2 76	55	160	2 91	55	169	
Walnut													4		0 00	4	-		5		
Citrus							623	1273	2 04	691	1900	2 75	722	2033	2 82	735	2134	2 90	756	1507	
Guava							75	165	2 20	80	205	2 56	84	219	2 61	84	230	2 74	84	244	
Strawberry																-	-				
Pomegranate																-	-				
Peach																-	-				
Pear							45	130	2 89	45	140	3 11	48	149	3 10	48	156	3 25	48	166	
Grape													1		0 00	1		0 00			
Pine apple							470	1825	3 88	475	1650	3 47	480	1765	3 68	480	1810	3 77	480	1919	
Banana							200	750	3 75	210	1600	7 62	222	1712	7 71	227	1798	7 92	232	1906	
Papaya							50	102	2 04	52	139	2 67	52	149	2 87	52	156	3 00	52	165	
Kiwi													2		0 00	2	-		2		
litchi							10	6	0 60	25	18	0 72	31	11	0 35	31	12	0 39	31	13	

Source: Statistical Abstract in respective years of Arunachal Pradesh, Itanagar

Area, production & productivity of *East Siang* Dist1992-00

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-20	
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn
Apple	96	195	2 03																	
Plum	32	70	2 19	137	350	2 55	72	55	0 76	72	230	3 19	72	232	3 22	72	244	3 39	72	258
Walnut	28	85	3 04																	
Citrus	815	1114	1 37	928	1350	1 45	852	1851	2 17	933	2670	2 86	972	2856	2 94	1005	2999-	2 98	1046	1509
Guava	125	280	2 24	190	328	1 73	135	277	2 05	143	175	1 22	145	153	1 06	145	161	1 11	145	171
Strawberry	-	-		-	-															
Pomegranate	10	7	0 70													-	-			
Peach	65	82	1 26													-	-			
Pear	66	275	4 17	106	391	3 69	61	280	4 59	61	290	4 75	61	310	5 08	61	326	5 34	61	346
Grape	-	-		-	-											-	-			
Pine apple	845	2456	2 91	855	3025	3 54	560	2013	3 59	560	2935	5 24	565	3140	5 56	571	3239	5 67	573	3433
Banana	294	593	2 02	641	2250	3 51	398	1592	4 00	418	2960	7 08	438	3167	7 23	444	3325	7 49	447	3524
Papaya	65	242	3 72	130	329	2 53	85	250	2 94	85	285	3 35	85	305	3 59	85	320	3 76	85	339
Kiwi				751	1025	1 36							2		0 00	2	-		2	
litchi	114			125	270	2 16	20	15	0 75	35	20	0 57	48	22	0 46	65	23	0 35	75	24

Source Statistical Abstract in respective years of Arunachal Pradesh. Itanagar

Area, production & productivity of Upper *Subansiri* Dist1992-00

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	175	150	0 86	20	149	7 45	20	149	7 45	20	149	7 45	22	159	7 23	22	167	7 59	22	13	0 59
Plum	30	50	1 67	8	40	5 00	8	40	5 00	10	70	7 00	11	70	6 36	11	73	6 64	11	77	7 00
Walnut	52	70	1 35																		
Citrus	1397	1124	0 80	614	1043	1 70	1035	2013	1 94				1093	2493	2 28	1110	2629	2 37	151	1259	8 34
Guava	80	75	0 94	10	50	5 00	15	60	4 00	20	90	4 50	22	96	4 36	22	101	4 59	22	107	4 86
Strawberry	-	-																			
Pomegranate	11	5	0 45	11	12	1 09	11	11	1 00	11	20	1 82	11	21	1 91	11	22	2 00	11	23	2 09
Peach	37	60	1 62	12	59	4 92	12	59	4 92	12	74	6 17	12	80	6 67	12	84	7 00	12	89	7 42
Pear	70	70	1 00	25	208	8 32	25	75	3 00	25	90	3 60	26	96	3 69	35	100	2 86	35	106	3 03
Grape	-	-											1		0 00	1	-		1		[illegible]
Pineapple	325	683	2 10	31	150	4 84	756	2303	3 05	760	2603	3 43	775	2785	3 59	783	2857	3 65	785	3028	3 86
Banana	78	181	2 32	159	1399	8 80	180	760	4 22	190	800	4 21	204	856	4 20	212	899	4 24	215	953	4 43
Papaya	65	77	1 18	10	50	5 00	10	53	5 30	12	93	7 75	12	99	8 25	12	104	8 67	12	118	9 83
Kiwi																-	-				
litchi	45	40	0 89													-	-				

Source: Statistical Abstract of Arunachal Pradesh of respective years

Area, production & productivity of Lower Subansiri Dist.1992-2000

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	pty
Apple	1250	1285	1 03	598	1389	2 32	614	1424	2 32	650	1424	2 19	684	1524	2 23	686	1600	2 33	694	900	1 30
Plum	100	65	0 65	111	435	3 92	120	445	3 71	125	550	4 40	128	588	4 59	133	617	4 64	133	654	4 92
Walnut	86	8	0 09	345	190	0 55	388	190	0 49	388	190	0 49	395	200	0 51	410	200	0 49	416	8	0 02
Citrus	200	160	0 80	387	665	1 72	288	527	1 83	294	540	1 84	323	578	1 79	347	907	2 61	376	412	1 10
Guava	40	65	1 63	46	217	4 72	46	220	4 78	50	170	3 40	52	288	5 54	53	302	5 70	53	320	6 04
Strawberry		-																			
Pomegranate	35	30	0 86	9	14	1 56	9	9	1 00	9	12	1 33	9	13	1 44	9	14	1 56	9	16	1 78
Peach	27	13	0 48	16	70	4 38	16	70	4 38	16	93	5 81	16	100	6 25	16	105	6 56	16	110	6 88
Pear	70	60	0 86	341	968	2 84	346	979	2 83	349	1053	3 02	361	1127	3 12	369	1185	3 21	373	1256	3 37
Grape																-					
Pineapple	139	353	2 54										15	7	0 47	15	7	0 47	15	7	0 47
Banana	56	72	1 09	230	958	4 17	255	565	2 22	265	570	2 15	276	610	2 21	276	641	2 32	280	579	2 43
Papaya	40	35	0 88	103	338	3 28	103	365	3 54	103	405	3 93	103	433	4 20	103	454	4 41	103	481	4 67
Kiwi																-	-				
Litchi	10	18	1 80	16	30	1 88	18	7	0 39	10	10	1 00	12	11	0 92	12	12	1 00	12	13	1 08

Source: Statistical Abstract of Arunachal Pradesh. 99-00.Itanagar

Area, production & productivity of *West kamang* Dist

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999	
Crop	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prodn	yield	Area	Prod	yield	Area	Prodn	yield	Area	Prodn
Apple	2425	5475	2 26	3695	5700	1 54	3862	7888	2 04	3987	8790	2.20	4073	9260	2 27	4149	9723	2.34	4234	5058
Plum	116	456	3 93	56	233	4 16	121	265	2 19	125	375	3 00	125	400	3 20	125	420	3 36	125	445
Walnut	694	73	0 11	770	350	0 45	830	350	0 42	840	440	0 52	852	447	0 52	857	447	0 52	887	30
Citrus	185	288	1 56	28	45	1 61	12	18	1 50	12	18	1 50	21	19	0 90	31	20	0 65	36	8
Guava	28	45	1 61	28	76	2 71	28	80	2 86	32	150	4 69	32	34	1 06	32	36	1 13	32	38
Strawberry	-	-											1		0 00	1		0 00	1	
Pomegranate	35	48	1 37	28	95	3 39	28	28	1 00	28	32	1 14	32	34	1 06	32	32	1 00	32	34
Peach	48	280	5 83	42	150	3 57	44	148	3 36	44	174	3 95	44	186	4 23	44	195	4 43	44	207
Pear	68	353	5 19	23	90	3 91	28	168	6 00	30	195	6 50	35	208	5 94	36	218	6 06	36	321
Grape	-	-		6	6	1 00	6	6	1 00	6	6	1 00	9	7	0 78	9	7	0 78	9	7
Pine apple	67	383	5 72													-	-			
Banana	46	580	12 61	15	36	2 40	15	30	2 00	25	50	2 00	25	53	2 12	25	56	2 24	25	59
Papaya	9	69	7 67	12	26	2 17	12	40	3 33	14	80	5 71	14	85	6 07	14	89	6 36	14	94
Kiwi																5	-		5	1
litchi													1			1	-		1	

Source : Statistical Abstract of the Respective year, Arunachal Pradesh, Itanagar

Area, production & productivity of East Kameng Dist

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-20	
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn
Apple	112	143	1 28	115	190	1 65	115	190	1 65	115	190	1 65	120	203	1 69	120	213	1 78	120	103
Plum	19	20	1 05	2	15	7 50	12	15	1 25	15	50	3 33	15	53	3 53	15	56	3 73	15	59
Walnut	26	5	0 19	58	16	0 28	58	16	0 28	58	16	0 28	58	16	0 28	58	16	0 28	58	
Citrus	310	395	1 27	97	210	2 16	22	78	3 55	22	78	3 55	58	83	1 43	100	87	0 87	207	35
Guava	53	98	1 85	80	202	2 53	80	205	2 56	87	230	2 64	89	246	2 76	91	258	2 84	91	273
Strawberry	-	-																		
Pomegranate	8	10	1 25										1		0 00	1	-		1	
Peach	25	20	0 80	12	59	4 92	12	59	4 92	12	74	6 17	12	79	6 58	12	83	6 92	12	88
Pear	53	75	1 42	5	52	10 40	5	50	10 00	5	40	8 00	10	43	4 30	19	45	2 37	27	47
Grape	-	-														-	-			
Pine apple	96	428	4 46										4		0 00	13	3	0 23	21	4
Banana	60	240	4 00	45	500	11 11	50	155	3 10	60	80	1 33	70	86	1 23	71	90	1 27	75	96
Papaya	32	45	1 41	23	105	4 57	23	108	4 70	25	148	5 92	25	158	6 32	25	160	6 40	25	170
Kiwi																13	-		13	
litchi	25	3	0 12	6	12	2 00	2	1	0 50	3	5	1 67	6	8	1 33	27	8	0 30	42	9

Source Statistical Abstract, Arunachal Pradesh, 1992-2000

Area, production & Productivity of Tawang Dist1992-2000

Year	1992-93			1994-95			1995-96			1996-97			1997-98			1998-99			1999-2000		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	pty
Apple	805	173 1	2 1 5	120 2	173 0	1 4 4	128 0	325 0	2 5 4	132 0	385 0	2 9 2	136 8	397 4	2 9 0	138 9	417 2	3 0 0	141 5	215 7	1 5 2
Plum	40	55	1 38	67	130	1 9 4	12 4	150	1 2 1	12 4	180	1.4 5	12 8	192	1 5 0	12 8	206	1 6 1	12 8	218	1 7 0
Walnut	22 3	33	0 15	57 5	149	0 2 6	69 5	136	0 2 0	71 0	286	0 4 0	72 3	283	0 3 9	74 8	283	0 3 8	76 4	12	0 0 2
Citrus	45	49	1 09	28	20	0 7 1	10	15	1 5 0	10	15	1 5 0	14	16	1 1 4	15	17	1 1 3	17	7	0.4 1
Guava	19	29	1 53	6	20	3 33	6	25	4 17	6	35	5 83	6	35	5 83	6	37	6 17	6	39	6 50
Strawberry	-	-														-	-				
Pomegranate	13	24	1 85	6	8	1 3 3	6	6	1 0 0	6	9	1 5 0	6	12	2 0 0	6	13	2 1 7	6	14	2 3 3
Peach	23	28	1 22	8	10	1 2 5	8	10	1 2 5	8	24	3 0 0	8	24	3 0 0	8	25	3 1 3	8	27	3.3 8
Pear	48	46	0 96	2	6	3.0 0	2	6	3 0 0	2	8	4 0 0	9	9	1 0 0	10	9	0 9 0	10	9	0.9 0
Grape	-	-		-									1			1			1		
Pine apple	-			-																	
Banana	19	74	3 89	-																	
Papaya	-			-																	
Kiwi				28																	
litchi	-																				

Source: Statistical Abstract of Arunachal Pradesh in respective Years,Itanagar

Annex IV. ⅎ

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

Lower Subansiri

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	1250	1285	1.03	598	1389	2.32	614	1424	2.32	650	1424	2.19	684	1524	2.23	686	1600	2.33	694	900	1.30
Plum	100	65	0.65	111	435	3.92	120	445	3.71	125	550	4.40	128	588	4.59	133	617	4.64	133	654	4.92
Walnut	86	8	0.09	345	190	0.55	388	190	0.49	388	190	0.49	395	200	0.51	410	200	0.49	416	8	0.02
Citrus	200	160	0.80	387	665	1.72	288	527	1.83	294	540	1.84	323	578	1.79	347	907	2.61	376	412	1.10
Guava	40	65	1.63	46	217	4.72	46	220	4.78	50	170	3.40	52	288	5.54	53	302	5.70	53	320	6.04
Strawber	-	-																			
Pomegra	35	30	0.86	9	14	1.56	9	9	1.00	9	12	1.33	9	13	1.44	9	14	1.56	9	16	1.78
Peach	27	13	0.48	16	70	4.38	16	70	4.38	16	93	5.81	16	100	6.25	16	105	6.56	16	110	6.88
Pear	70	60	0.86	341	968	2.84	346	979	2.83	349	1053	3.02	361	1127	3.12	369	1185	3.21	373	1256	3.37
Grape	-	-														-	-				
Pine app	139	353	2.54	-	-								15	7	0.47	15	7	0.47	15	7	0.47
Banana	66	72	1.09	230	958	4.17	255	565	2.22	265	570	2.15	276	610	2.21	276	641	2.32	280	679	2.43
Papaya	40	35	0.88	103	338	3.28	103	365	3.54	103	405	3.93	103	433	4.20	103	454	4.41	103	481	4.67
Kiwi																-	-				
litchi	10	18	1.80	16	30	1.88	18	7	0.39	10	10	1.00	12	11	0.92	12	12	1.00	12	13	1.08

Source Statistical Abstract in Arunachal Pradesh 1999-2000

Tawang

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	805	1731	2.15	1202	1730	1.44	1280	3250	2.54	1320	3850	2.92	1368	3974	2.90	1389	4172	3.00	1415	2157	1.52
Plum	40	55	1.38	67	130	1.94	124	150	1.21	124	180	1.45	128	192	1.50	128	206	1.61	128	218	1.70
Walnut	223	33	0.15	575	149	0.26	695	136	0.20	710	286	0.40	723	283	0.39	748	283	0.38	764	12	0.02
Citrus	45	49	1.09	28	20	0.71	10	15	1.50	10	15	1.50	14	16	1.14	15	17	1.13	17	7	0.41
Guava	19	29	1.53	6	20	3.33	6	25	4.17	6	35	5.83	6	35	5.83	6	37	6.17	6	39	6.50
Strawber	-	-														-	-				
Pomegra	13	24	1.85	6	8	1.33	6	6	1.00	6	9	1.50	6	12	2.00	6	13	2.17	6	14	2.33
Peach	23	28	1.22	8	10	1.25	8	10	1.25	8	24	3.00	8	24	3.00	8	25	3.13	8	27	3.38
Pear	48	46	0.96	2	6	3.00	2	6	3.00	2	8	4.00	9	9	1.00	10	9	0.90	10	9	0.90
Grape	-	-		-	-								1			1 -			1		
Pine app	-			-	-																
Banana	19	74	3.89	-	-																
Papaya	-			-	-																
Kiwi																					
litchi	-																				

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

West Kameng

	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	2425	5475	2.2577	3695	5700	1.54	3862	7888	2.04	3987	8790	2.20	4073	9260	2.27	4149	9723	2.343	4234	5058	1.19
Plum	116	456	3.931	56	233	4.16	121	265	2.19	125	375	3.00	125	400	3.20	125	420	3.36	125	445	3.56
Walnut	694	73	0.1052	770	350	0.45	830	350	0.42	840	440	0.52	852	447	0.52	857	447	0.522	887	30	0.03
Citrus	185	288	1.5568	28	45	1.61	12	18	1.50	12	18	1.50	21	19	0.90	31	20	0.645	36	8	0.22
Guava	28	45	1.6071	28	76	2.71	28	80	2.86	32	150	4.69	32	34	1.06	32	36	1.125	32	38	1.19
Strawber	-	-											1			1		0	1		0.00
Pomegra	35	48	1.3714	28	95	3.39	28	28	1.00	28	32	1.14	32	34	1.06	32	32	1	32	34	1.06
Peach	48	280	5.8333	42	150	3.57	44	148	3.36	44	174	3.95	44	186	4.23	44	195	4.432	44	207	4.70
Pear	68	353	5.1912	23	90	3.91	28	168	6.00	30	195	6.50	35	208	5.94	36	218	6.056	36	321	8.92
Grape	-	-		6	6	1.00	6	6	1.00	6	6	1.00	9	7	0.78	9	7	0.778	9	7	0.78
Pine app	67	383	5.7164												-	-					
Banana	46	580	12.609	15	36	2.40	15	30	2.00	25	50	2.00	25	53	2.12	25	56	2.24	25	59	2.36
Papaya	9	69	7.6667	12	26	2.17	12	40		14	80	5.71	14	85	6.07	14	89	6.357	14	94	6.71
Kiwi																5			5	1	0.20
litchi													1			1			1		

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

Changlang

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	37	69	1.86	37	80	2.16	37	80	2.16	37	80	2.16	37	85	2.30	37	89	2.41	37	30	0.81
Plum	25	40	1.60	25	70	2.80	25	70	2.80	26	70	2.69	26	72	2.77	26	76	2.92	26	82	3.15
Walnut	20	3	0.15	27	7	0.26	27	7	0.26	27	7	0.26	27	8	0.30	27	8	0.30	27		0.00
Citrus	285	460	1.61	287	425	1.48	117	255	2.18	112	285	2.54	134	304	2.27	150	319	2.13	187	150	0.80
Guava	68	125	1.84	70	180	2.57	90	200	2.22	95	110	1.16	97	117	1.21	97	123	1.27	97	130	1.34
Strawber	-	-													-	-					
Pomegra	25	9	0.36	26	30	1.15	26	26	1.00	26	35	1.35	26	37	1.42	26	39	1.50	26	41	1.58
Peach	43	52	1.21	50	155	3.10	50	155	3.10	50	203	4.06	50	217	4.34	50	228	4.56	50	242	4.84
Pear	40	105	2.63	43	164	3.81	43	164	3.81	43	114	2.65	47	122	2.60	50	128	2.56	54	136	2.52
Grape	-	-		-	-																
Pine app	235	380	1.62	115	1202	10.45	115	1252	10.89	115	1510	13.13	120	1615	13.46	123	1657	13.47	129	1756	13.61
Banana	240	900	3.75	310	1005	3.24	360	775	2.15	370	860	2.32	375	952	2.54	329	1000	3.04	343	1060	3.09
Papaya	51	77	1.51	55	159	2.89	65	170	2.62	65	220	3.38	65	235	3.62	65	246	3.78	65	260	4.00
Kiwi																					
litchi	43	30	0.70	45	32	0.71	15	10	0.67	29	20	0.69	39	22	0.56	50	21	0.42	60	22	0.37

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

Papumpare

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	-	-																			
Plum	70	50	0 71	73	165	2 26	73	185	2 53	73	180	2 47	73	180	2.47	73	189	2.59	73	200	2 74
Walnut																					
Citrus	107	112	1 05	117	132	1 13	61	75	1 23	61	75	1.23	97	80	0 82	122	84	0.69	177	36	0 20
Guava	33	60	1 82	35	180	5 14	35	190	5.43	40	250	6.25	40	267	6 68	40	280	7 00	40	297	7 43
Strawber -		-																			
Pomegra	40	40	1.00	37	39	1.05	37	28	0.76	37	32	0 86	37	34	0 92	37	38	1 03	37	40	1 08
Peach	21	13	0 62	21	98	4 67	21	98	4 67	21	125	5.95	21	133	6 33	21	140	6.67	21	148	7.05
Pear	68	60	0.88	32	65	2 03	32	65	2.03	32	65	2.03	32	70	2 19	32	74	2.31	32	78	2 44
Grape	-	-													-	-					
Pine app	97	295	3 04	97	430	4 43	97	560	5 77	97	560	5.77	111	599	5.40	117	614	5 25	117	651	5 56
Banana	50	60	1 20	75	132	1 76	79	125	1.58	89	150	1 69	105	161	1.53	113	169	1.50	121	179	1 48
Papaya	40	30	0 75	43	100	2 33	48	120	2.50	50	160	3 20	50	171	3 42	50	179	3 58	50	190	3 80
Kiwi															-	-					
litchi	13	17	1.31 -	-									- 7			17 -			32		

Source: Statistical Abstract in Arunachal Pradesh 1999-2000

Dibang Valley

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	154	235	1 53 -	-			20	5	0.25	35	10	0 29	40	11	0.28	43	12	0 28	42	2	0 05
Plum	43	215	5.00	63	195	3 10	65	195	3.00	63	165	2 62	63	167	2 65	63	174	2 76	63	184	2 92
Walnut	3	1	0.33	3	1	0 33	3	1	0.33	3	1	0.33	5	2	0 40	7	2	0.29	7		0 00
Citrus	120	72	0 60	299	658	2 20	215	348	1.62	230	385	1 67	255	412	1.62	308	432	1 40	375	212	0 57
Guava	49	75	1 53	59	96	1 63	65	100	1 54	75	100	1 33	78	107	1 37	78	112	1 44	78	119	1 53
Strawber -		-													-	-					
Pomegra	6	4	0.67	5	5	1.00	5	4	0.80	5	5	1 00	5	5	1.00	5	5	1 00	5	5	1 00
Peach	19	124	6.53	19	37	1 95	19	37	1.95	19	56	2 95	19	60	3.16	19	63	3 32	19	67	3 53
Pear	105	261	2 49	25	88	3 52	25	88	3.52	25	90	3 60	25	96	3.84	25	100	4.00	25	106	4.24
Grape	-	-	-	-																	
Pine app	92	275	2.99	40	395	9.88	40	380	9 50	40	380	9 50	43	407	9 47	43	417	9 70	51	442	8.67
Banana	125	500	4.00	374	1610	4.30	390	488	1.25	400	600	1 50	420	642	1 53	430	674	1.57	445	714	1 60
Papaya	29	57	1 97	40	360	9 00	40	370	9 25	40	391	9 78	40	418	10 45	40	440	11 00	40	466	11 65
Kiwi																					
litchi	16	19	1.19	19	25	1.32	13	13	1.00	20	20	1 00	27	22	0.81	34	24	0.71	43	25	0 58

Source. Statistical Abstract in Arunachal Pradesh. 1999-2000

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

Tirap

	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	58	75	1.29 -	-												-	-				
Plum	25	18	0 72	43	145	3 37	43	145	3 37	45	190	4 22	45	175	3 89	45	184	4 09	45	195	4 33
Walnut			-	-												7 -			15		0 00
Citrus	212	682	3 22	246	705	2 87	135	205	1 52	139	212	1 53	172	226	1 31	203	237	1 17	297	130	0 44
Guava	62	45	0 73	85	180	2 12	115	215	1 87	120	297	2 48	122	317	2 60	122	333	2 73	122	353	2 89
Strawber -	-															-	-				
Pomegra	17	10	0 59	17	24	1 41	17	17	1 00	17	30	1 76	17	[illegible]	1 88	17	34	2 00	17	36	2 12
Peach	45	75	1 67	45	70	1 56	45	70	1 56	45	92	2 04	45	[illegible]	2 18	45	102	2 27	45	108	2 40
Pear	58	80	1 38	58	90	1 55	58	70	1 21	58	70	1 21	[illegible]	[illegible]	1 28	58	78	1 34	58	83	1 43
Grape -	-			6	6	1 00															
Pine app	195	249	1 28	50	365	7 30	50	75	1 50	50	75	1 50	[illegible]	[illegible]	1 58	58	82	1 41	62	87	1 40
Banana	270	610	2 26	320	870	2 72	360	450	1 25	406	700	1 72	426	749	1 76	431	786	1 82	440	833	1 89
Papaya	70	37	0 53	75	235	3 13	85	250	2 94	27	280	10 37	[illegible]	[illegible]	3 45	87	315	3 62	87	334	3 84
Kiwi																					
litchi	33	11	0 33	7	9	1 29	4	3	0 75	12	10	0 83	[illegible]	[illegible]	[illegible]	32	12	[illegible]	46	13	0 28

Source Statistical Abstract in Arunachal Pradesh 1999-2000

East Siang

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	96	195	2 03																		
Plum	32	70	2 19	137	350	2 55	72	55	0 76	72	230	3 19	72	232	3 22	72	244	3 39	72	258	3 58
Walnut	28	85	3 04																		
Citrus	815	1114	1 37	928	1350	1 45	852	1851	2 17	933	2670	2 86	972	2856	2 94	1005	2999	2 98	1046	1509	1 44
Guava	125	280	2.24	190	328	1 73	135	277	2 05	143	175	1 22	145	153	1 06	145	161	1 11	145	171	1 18
Strawber -		-		-	-																
Pomegra	10	7	0.70												-	-					
Peach	65	82	1 26												-	-					
Pear	66	275	4 17	106	391	3 69	61	280	4.59	61	290	4 75	61	310	5 08	61	326	5 34	61	346	5 67
Grape -		-		-	-							s			-	-					
Pine app	845	2456	2.91	855	3025	3 54	560	2013	3 59	560	2935	5.24	565	3140	5 56	571	3239	5 67	573	3433	5 99
Banana	294	593	2.02	641	2250	3 51	398	1592	4.00	418	2960	7 08	438	3167	7 23	444	3325	7 49	447	3524	7 88
Papaya	65	242	3.72	130	329	2 53	85	250	2.94	85	285	3 35	85	305	3 59	85	320	3 76	85	339	3 99
Kiwi				751	1025	1.36							2		0 00	2 -			2		0 00
litchi	114 -			125	270	2.16	20	15	0 75	35	20	0 57	48	22	0 46	65	23	0 35	75	24	0 32

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

East Kameng

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	112	143	1 28	115	190	1 65	115	190	1 65	115	190	1.65	120	203	1 69	120	213	1 78	120	103	0 86
Plum	19	20	1 05	2	15	7 50	12	15	1 25	15	50	3 33	15	53	3 53	15	56	3 73	15	59	3 93
Walnut	26	5	0 19	58	16	0 28	58	16	0 28	58	16	0 28	58	16	0 28	58	16	0 28	58		0 00
Citrus	310	395	1 27	97	210	2 16	22	78	3 55	22	78	3 55	58	83	1 43	100	87	0 87	207	35	0 17
Guava	53	98	1 85	80	202	2 53	80	205	2 56	87	230	2 64	89	246	2 76	91	258	2 84	91	273	3 00
Strawber -		-																			
Pomegra	8	10	1 25										1		0 00	1 -			1		0 00
Peach	25	20	0.80	12	59	4.92	12	59	4.92	12	74	6.17	12	79	6.58	12	83	6 92	12	88	7.33
Pear	53	75	1.42	5	52	10 40	5	50	10 00	5	40	8.00	10	43	4 30	19	45	2 37	27	47	1 74
Grape	-	-													-	-					
Pine app	96	428	4.46										4		0.00	13	3	0 23	21	4	0 19
Banana	60	240	4 00	45	500	11.11	50	155	3.10	60	80	1.33	70	86	1.23	71	90	1 27	75	96	1.28
Papaya	32	45	1 41	23	105	4 57	23	108	4 70	25	148	5 92	25	158	6.32	25	160	6 40	25	170	6 80
Kiwi																13 -			13		0 00
litchi	25	3	0 12	6	12		2	1	0.50	3	5	1.67	6	8	1 33	27	8	0 30	42	9	0 21

Source Statistical Abstract in Arunachal Pradesh, 1999-2000

West Sinag

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	141	192	1 36										4			46	138	3 00	14		0 00
Plum	32	95	2 97	42	100	2.38	42	100	2 38	45	130	2 89	46	131	2 85	4 -			46	146	3 17
Walnut	32	70	2.19										1		0 00	3638	10803	2 97	8		0 00
Citrus	1485	3634	2.45	3184	3900	1.22	3501	6604	1.89	3594	9612	2.67	3611	10289	2 85	102	393	3 85	3722	5810	1.56
Guava	50	340	6.80	80	100	1 25	95	205	2.16	100	350	3 50	102	374	3 67 -	-			102	417	4 09
Strawber -		-													-	-					
Pomegra	15	10	0.67												-	-					
Peach	40	164	4.10												-	-					
Pear	80	570	7.13	60	120	2 00	60	110	1.83	60	110	1.83	61	117	1 92	61	123	2 02	61	130	2 13
Grape	-	-													-	-					
Pine app	1450	7368	5.08	5449	11093	2.04	4961	13827	2.79	4970	17917	3 61	4980	18604	3 74	4978	19089	3 83	4982	20234	4.06
Banana	110	400	3.64	506	1242	2.45	535	1000	1.87	585	1200	2.05	595	1074	1 81	646	1127	1 74	696	1195	1 72
Papaya	121	219	1.81 -		-										-	-					
Kiwi													3			3 -			3		
litchi	39	95	2.44										12			19 -			24		

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

Upper Subansiri

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	175	150	0 86	20	149	7 45	20	149	7 45	20	149	7 45	22	159	7 23	22	167	7.59	22	13	0.59
Plum	30	50	1 67	8	40	5 00	8	40	5 00	10	70	7 00	11	70	6.36	11	73	6 64	11	77	7 00
Walnut	52	70	1 35																		
Citrus	1397	1124	0 80	614	1043	1 70	1035	2013	1.94				1093	2493	2.28	1110	2629	2.37	151	1259	8 34
Guava	80	75	0 94	10	50	5 00	15	60	4 00	20	90	4 50	22	96	4.36	22	101	4 59	22	107	4 86
Strawber -	-																				
Pomegra	11	5	0 45	11	12	1 09	11	11	1 00	11	20	1 82	11	21	1.91	11	22	2.00	11	23	2 09
Peach	37	60	1.62	12	59	4.92	12	59	4 92	12	74	6 17	12	80	6.67	12	84	7 00	12	89	7.42
Pear	70	70	1.00	25	208	8 32	25	75	3.00	25	90	3 60	26	96	3.69	35	100	2 86	35	106	3 03
Grape -	-												1		0.00	1	-		1		0 00
Pine app	325	683	2.10	31	150	4 84	756	2303	3 05	760	2603	3.43	775	2785	3.59	783	2857	3.65	785	3028	3 86
Banana	78	181	2.32	159	1399	8 80	180	760	4.22	190	800	4.21	204	856	4.20	212	899	4.24	215	953	4 43
Papaya	65	77	1.18	10	50	5 00	10	53	5 30	12	93	7 75	12	99	8.25	12	104	8 67	12	118	9.83
Kiwi																-	-				
Iitchi	45	40	0 89													-	-				

Source Statistical Abstract in Arunachal Pradesh, 1999-2000

Upper Siang

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple																-	-				
Plum							55	140	2.55	55	150	2 73	55	152	2 76	55	160	2 91	55	169	3 07
Walnut													4			4	-		5		0.00
Citrus							623	1273	2.04	691	1900	2.75	722	2033	2.82	735	2134	2 90	756	1507	1 99
Guava							75	165	2.20	80	205	2.56	84	219	2.61	84	230	2.74	84	244	2 90
Strawberry																-	-				
Pomegranate																-	-				
Peach																-	-				
Pear							45	130	2.89	45	140	3.11	48	149	3.10	48	156	3 25	48	166	3.46
Grape													1			1		0 00			
Pine apple							470	1825	3.88	475	1650	3.47	480	1765	3 68	480	1810	3 77	480	1919	4.00
Banana							200	750	3.75	210	1600	7 62	222	1712	7 71	227	1798	7 92	232	1906	8 22
Papaya							50	102	2 04	52	139	2 67	52	149	2 87	52	156	3 00	52	165	3 17
Kiwi													2		0.00	2	-		2		0 00
Iitchi							10	6	0.60	25	18		31	11	0 35	31	12	0 39	31	13	0 42

Source: Statistical Abstract in Arunachal Pradesh, 1999-2000

District -wise Area, Production & Productivity of Horticultural Crops in Arunachal Pradesh

Lohit

Year	92-93			94-95			95-96			96-97			97-98			98-99			99-00		
Crop	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prodn	Pty	Area	Prod	Pty	Area	Prodn	Pty	Area	Prodn	Pty
Apple	83	170	2.05	42	12	0.29	22	7	0.32	22	7	0.32	22	9	0.41	22	10	0.45	22	2	0.09
Plum	48	70	1.46	12	50	4.17	12	50	4.17	12	70	5.83	12	72	6.00	12	76	6.33	12	82	6.83
Walnut	22	8	0.36	12 -			12		0.00	12		0.00	12	2	0.17	12	2	0.17	12		0.00
Citrus	348	982	2.82	635	1093	1.72	100	373	3.73				171	406	2.37	199	426	2.14	246	240	0.98
Guava	152	40	0.26	50	111	2.22	65	150	2.31	90	230	2.56	92	246	2.67	92	258	2.80	92	273	2.97
Strawber -	-															-	-				
Pomegra	5	8	1.60	20	1	0.05	2	1	0.50	2	5	2.50	2	5	2.50	2	5	2.50	2	5	2.50
Peach	47	70	1.49	12	24	2.00	12	24	2.00	12	35	2.92	12	37	3.08	12	38	3.17	12	40	3.33
Pear	50	153	3.06	30	35	1.17	30	35	1.17	30	45	1.50	30	48	1.60	30	50	1.67	30	53	1.77
Grape -	-			-	-																
Pine app	145	820	5.66	63	335	5.32	76	370	4.87	76	370	4.87	79	395	5.00	89	395	4.44	99	419	4.23
Banana	400	3800	9.50	150	1079	7.19	170	830	4.88	180	900	5.00	194	963	4.96	200	1011	5.06	210	1072	5.10
Papaya	35	42	1.20	40	102	2.55	50	112	2.24	52	152	2.92	52	162	3.12	52	170	3.27	52	180	3.46
Kiwi																					
litchi	25	22	0.88	12	5	0.42	203	70	0.34	230	80	0.35	245	86	0.35	255	90	0.35	273	95	0.35

Source: Statistical Abstract in Arunachal Pradesh 1999-2000

Annual average rainfall of Arunachal Pradesh (1991-2001)

RGS	January	February	March	April	May	June	July	August	September	October	November	December
Ziro	28	44 58	80 31	144 9	142 9	254.3	247.5	217.2	91.77	60 91	21 74	18.61
Yingkiong	62 58	157 85	278 24	470 84	371 59	457.07	328.24	338 6	180.7	195 32	80 07	61.42
Tezu	47.63	125 8	329 4	438.7	649 1	746 8	817.5	558 1	425.1	167	35.87	26.19
Tawang	8.4	40 85	164.6	266.7	346.6	343 1	435.7	493 8	273.7	138 5	40.62	21.48
Sewa	32.78	86.88	116 7	278 1	402 8	722.1	562.9	501.2	353.3	188.7	51.87	23 2
Seppa	34.1	38.54	62.81	90 85	212 6	413.8	366	292 27	250.18	109 54	22.27	19.72
Seijosa	25.67	38.34	64.22	113 5	314 8	538.4	612.4	573 6	341.4	176 5	34 67	13.42
Roing	49.4	98 41	209 5	246	447 8	606 5	651 3	420 3	315.5	161	32 59	32 47
Pasighat	36 6	63 92	129 7	197	449 2	806 1	772.3	608 1	366 1	177 1	33 24	13.16
Namsai	44.3	162 3	264 4	376.8	497 2	408 4	460.7	395 3	302.7	213 2	14.64	14.93
Miao	83.42	120.4	173.1	258 4	288 3	446.6	459 5	418 5	300.5	156 1	46.12	14.55
Longding	30.18	59.62	113.2	173 4	368 3	482 3	504.9	502 9	339.9	175.5	64.47	10.76
Khonsa	52.67	79.01	176.7	224 9	498	744 7	893.2	594 2	499 6	216 5	36.41	17.67
Itanagar	74 24	80.05	82.87	241	617 5	889 4	665.9	617.5	424.9	200.3	29.61	14.24
Hayuliang	115	231 1	487 1	664 8	748	607 2	452	244 9	277.4	133 8	36.53	57.08
Doimukh	29 76	51 4	98 71	229 1	534 2	778.6	552.8	445.4	397 1	161	30.65	14.9
Daporijo	60.88	135.5	169.2	157 6	206	524.8	360.9	337.7	252.5	186.9	25.55	21.6
Changlang	30 66	54 86	117.6	189 3	341 8	387.4	452	326 8	285 1	112.7	12.1	7.982
Bomdila	25.01	37 74	41.67	74 81	140.22	265 48	307 65	369.79	232 01	81 5	34.2	11.21
Along	43 87	81 67	116.7	156	233 6	449.2	372.7	329.8	265 5	124 1	32.7	24.58

Source: State Rural Works Dept. Itanagar, Arunachal Pradesh

Annual average temperature of Arunachal Pradesh (1991-2002)

	January		February		March		April		May		June		July		August		September		October		November		December	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1991	19.57	4 22	21 45	5.80	23 86	9.45	24.58	11 50	27 84	13 94	29 35	17 60	29 17	19.92	30.08	19 47	29.83	23 10	30.00	17.66	22.91	10.55	19 42	6 58
1992	19.36	4 70	19.06	5.68	23.90	8.23	26.85	12 70	27 15	12 83	30.86	17.78	29.61	19.32	30 66	18 63	31.72	17 12	26 46	11 53	24 86	8 82	20.44	5 72
1993	18.81	5.61	21 37	6 05	24.38	8.82	57.57	11 45	30.27	15.07	31.65	17.10	30.40	19.27	30.47	17.52	28.74	17.51	27.26	13.30	24.83	10.77	22.14	7.02
1994	19.95	6.80	19 27	7 40	23.94	9 38	28 58	11 38	31 19	15 45	33 09	17 86	34 65	19 04	33 18	19.54	32.69	18 16	28 51	13 90	24.47	9 85	20 73	6 13
1995	20.21	6 30	1 93	6.90	25 09	8.90	27 72	11.84	30.81	14 95	32 16	18.18	31 60	17 92	31 40	18 25	32 16	18.10	29.25	13 80	26 93	12.50	20.43	7.06
1996	20.04	7.11	22 27	8 09	27.35	9 40	30 27	12 31	30 89	14.00	33 13	16.80	32.95	17.38	32 14	19 38	31.83	18 20	29 05	13 72	27 00	10.55	22.66	8.05
1997	21.40	6 00	20 38	5.95	25 70	9 89	29 33	11 60	31.04	16.21	32.80	17 40	33 80	19 22	35.17	20.56	31.03	16.80	29.00	13 30	27 02	11.60	22.79	7 55
1998	21.63	7.08	23.58	8.53	27 02	10.81	31 28	13 77	34.62	18 00	32.72	19 61	33.75	22.65	32.72	20.75	34.67	20 86	32.25	16 77	27.98	12.22	25.72	8 92
1999	22.79	5.73	26.65	8.13	29.01	10 57	31.73	12.72	31.44	14 90	33 32	17.43	33 04	17.68	33 81	17 90	32 50	17 87	30.77	15.09	28.00	10.55	23.60	7.22
2000	19.98	4.67	21.95	5.41	28 50	7.68	28.35	13 05	33 30	15 84	33.45	18.00	33.00	19.30	31.97	18.88	32.01	16.74		12 66		9.8		7.08
2001	21.26	6.10	24 83	7.45	26.36	9.79	28.11	12 53	31.85	15 16	33 50	17.15	35 32	18.47	32.53	19.07	31.38	17 53	29.57	13.84	26.52	10.07	21.22	6.40
2002	20.60	3.10	24 30	5.00	26.00	6.10	27 00	7.30	32 60	10 50	34 00	15.33												

[illegible]